

SIGN 1, EXIT



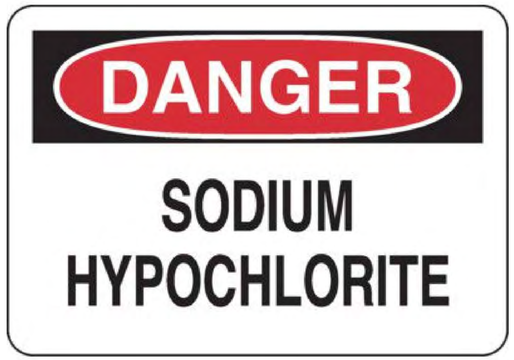
SIGN 2, SHOWER/EYE WASH



SIGN 3, SH 12.5%

NOTES:

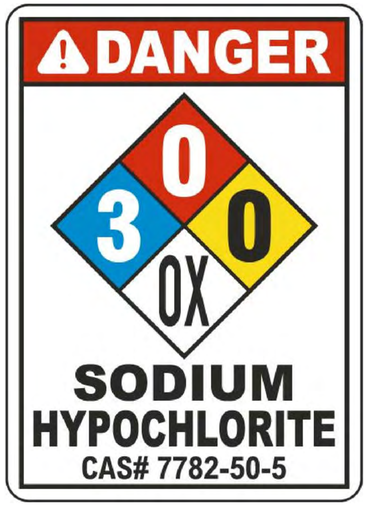
1. INSTALL NEW SIGNS PER LOCATIONS SHOWN ON M-01, M-07 AND M-15.



SIGN 4, DANGER



SIGN 5, NOTICE SAFETY GLASSES



SIGN 6, NFPA 704 DIAMOND



SIGN 7, NO SMOKING

REV	ISSUED FOR	DATE	BY

PROJECT ENGINEER:	J. BOWDAN
DESIGNED BY:	A. QIU
DRAWN BY:	J. COPPOLA
CHECKED BY:	P. COOKE

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE 0 1/2" 1"

Hazen
HAZEN AND SAWYER
4000 HOLLYWOOD BLVD SUITE 750N
HOLLYWOOD, FL 33021

CITY OF HOLLYWOOD
HOLLYWOOD, FLORIDA

SODIUM HYPOCHLORITE
TEMPORARY STORAGE AND FEED SYSTEM

MECHANICAL
CHEMICAL SIGNAGE DETAILS

DATE:	DECEMBER 2025
HAZEN NO.:	4321-111
CONTRACT NO.:	22-8073
DRAWING NUMBER:	M-19

File: C:_DC\ACCDOCS\HAZEN AND SAWYER\04321-111\PROJECT FILES\1-DESIGN\01-HAZEN\MECHM-19 Saved by JCOPPOLA Save date: 12/2/2025 4:49 PM
PLOT DATE: 12/22/2025 11:09 AM BY: JCOPPOLA

GENERAL STRUCTURAL NOTES

G-1 THESE NOTES ARE GENERAL AND SUPPLEMENT THE SPECIFICATIONS. THESE NOTES APPLY TO THE ENTIRE PROJECT UNLESS MODIFIED OR NOTED OTHERWISE IN THE CONTRACT DOCUMENTS.

G-2 STANDARD DETAILS SHALL BE USED WHEN REFERRED TO OR WHEN NO MORE RESTRICTIVE OR DIFFERENT DETAILS ARE SHOWN ON THE DRAWINGS.

G-3 DESIGN IS IN ACCORDANCE WITH AND CONSTRUCTION SHALL COMPLY WITH THE PROVISIONS OF THE 2023 FLORIDA BUILDING CODE. THE DESIGN LOADS AND OTHER DESIGN VALUES GIVEN IN NOTES G-4 THROUGH G-8 WERE USED FOR DESIGN OF STRUCTURES UNLESS NOTED OTHERWISE ON THE DRAWINGS.

G-4 LIVE LOADS:

STRUCTURE \ LEVEL	ROOF	TOP / FIRST FLOOR	BOTTOM / GROUND FLOOR
SODIUM HYPOCHLORITE FACILITY	20 PSF	N/A	250 PSF

-ALL STAIRWAYS, LANDINGS AND PLATFORMS ARE DESIGNED FOR A LIVE LOAD = 100 PSF UNLESS NOTED OTHERWISE.

G-5 WIND DESIGN CRITERIA:

BASIC DESIGN WIND SPEED (V) = 180 MPH
RISK CATEGORY = III
WIND EXPOSURE = C

STRUCTURE \ PARAMETER	PRESSURE COEFFICIENT GCpi	LATERAL LOAD RESISTING SYSTEM
SODIUM HYPOCHLORITE FACILITY	N/A	STEEL MOMENT FRAME

G-6 RAIN LOAD:
RAIN INTENSITY (i) = 5 IN/HR

G-7 ALL DIMENSIONS INDICATED FOR EXISTING STRUCTURES SHALL BE VERIFIED BY FIELD MEASUREMENT. ALL DIMENSIONS THAT ARE CONTROLLED BY OR RELATED TO EQUIPMENT SHALL BE VERIFIED BY THE CONTRACTOR WITH THE MANUFACTURER SHOP DRAWINGS PRIOR TO CONSTRUCTION.

G-8 THE CONTRACTOR IS RESPONSIBLE FOR VERIFYING ALL EXISTING INFORMATION IN THE FIELD AS REQUIRED FOR NEW WORK.

G-9 IF A CONFLICT IS FOUND BETWEEN DIFFERENT PORTIONS OF THE CONTRACT DOCUMENTS, THE CONTRACTOR SHALL NOTIFY THE ENGINEER IMMEDIATELY. CONTINUED CONSTRUCTION OF THE AREA IN CONFLICT SHALL BE AT THE CONTRACTOR'S OWN RISK UNTIL THE CONFLICT IS RESOLVED.

G-10 EQUIPMENT ANCHOR SIZES, TYPES, EMBEDMENT AND PATTERNS SHALL BE DESIGNED BY THE MANUFACTURER OF THE EQUIPMENT. IF EQUIPMENT MANUFACTURER IS UNABLE TO PROVIDE DESIGN OF ANCHOR EMBEDMENT, DESIGN SHALL BE BY ENGINEER RETAINED BY CONTRACTOR BASED ON LOADS PROVIDED BY EQUIPMENT MANUFACTURER. CONTRACTOR SHALL SUBMIT SIZE, PLACEMENT, AND EMBEDMENT REQUIREMENTS. ALL ANCHOR PATTERNS SHALL BE TEMPLATED TO ENSURE ACCURACY OF PLACEMENT.

G-11 STRUCTURAL DRAWINGS SHALL BE USED IN COORDINATION WITH THE DRAWINGS OF ALL OTHER DISCIPLINES AND MANUFACTURER'S SHOP DRAWINGS.

G-12 STRUCTURES HAVE BEEN DESIGNED FOR OPERATIONAL LOADS ON THE COMPLETED STRUCTURE. DURING CONSTRUCTION, THE STRUCTURES SHALL BE PROTECTED BY BRACING AND TEMPORARY SUPPORTS WHEREVER EXCESSIVE CONSTRUCTION LOADS MAY OCCUR. OVERSTRESSING OF ANY STRUCTURAL ELEMENT IS PROHIBITED.

G-13 IF CONTRACTOR DESIRES TO TEMPORARILY PLACE OR MOVE LOADS ON OR ADJACENT TO EXISTING STRUCTURES OR UTILITIES DURING CONSTRUCTION PROCESS, CONTRACTOR IS EXCLUSIVELY RESPONSIBLE FOR MAINTAINING STRUCTURAL INTEGRITY AND AVOIDING OVERSTRESSING AND DAMAGING EXISTING STRUCTURES AND UTILITIES. CONTRACTOR SHALL SUBMIT STRUCTURAL CALCULATIONS AND DRAWINGS VERIFYING THAT PROPOSED CONSTRUCTION (INCLUDING APPLICATION OF TEMPORARY CONSTRUCTION LOADS) WILL NOT OVERSTRESS OR DAMAGE EXISTING STRUCTURES AND UTILITIES. DRAWINGS AND CALCULATIONS SHALL BE SEALED BY A PROFESSIONAL ENGINEER CURRENTLY REGISTERED IN THE STATE OF FLORIDA.

STRUCTURAL METALS

M-1 DETAIL, FABRICATE, AND ERECT STRUCTURAL STEEL IN ACCORDANCE WITH ANSI/AISC 360 SPECIFICATION FOR STRUCTURAL STEEL BUILDINGS, LATEST EDITION.

M-2 STEEL MATERIAL:

A)	STRUCTURAL HSS:	ASTM A500, GRADE C (46/50 KSI) OR A1085 GRADE A (50 KSI)
B)	STRUCTURAL PIPE:	ASTM A53, GRADE B (35 KSI)
C)	PLATES AND BARS:	ASTM A36 UNO (36 KSI)
D)	STRUCTURAL W, C, & MC SHAPES:	ASTM A992 (50 KSI)
E)	STRUCTURAL HP, M, S, & L SHAPES:	ASTM A572 GRADE 50 (50 KSI)
F)	ANCHOR RODS:	ASTM F1554 GRADE 55 (55 KSI)

M-3 PROVIDE MINIMUM 3/4" DIAMETER ASTM F3125 GRADE A325 TYPE 1 OR GRADE F1852 TYPE 1 HIGH STRENGTH BOLTS WITH SNUG TIGHTENED TYPE N CONNECTIONS FOR STRUCTURAL STEEL UNLESS NOTED OTHERWISE. HOLES FOR BOLTS SHALL BE STANDARD SIZE UNLESS NOTED OTHERWISE.

M-4 PROVIDE TYPICAL STEEL BEAM CONNECTIONS FOR A CAPACITY OF NOT LESS THAN ONE HALF OF THE TOTAL UNIFORM LOAD CAPACITY TABULATED IN THE AISC TABLES FOR ALLOWABLE LOADS OF BEAMS UNLESS NOTED OTHERWISE.

M-5 DO NOT PAINT STEEL SURFACES WHICH ARE TO BE WELDED OR ARE TO BE ENCASED IN CONCRETE.

M-6 DETAIL, FABRICATE, AND ERECT STRUCTURAL STAINLESS STEEL IN ACCORDANCE WITH ANSI/AISC 370 SPECIFICATION FOR STRUCTURAL STAINLESS STEEL BUILDINGS, LATEST EDITION. ALL STAINLESS STEEL FABRICATIONS EXPOSED TO UNDERWATER SERVICE, IN CONFINED AREAS CONTAINING FLUID, AND IN CORROSIVE ENVIRONMENTS SHALL BE TYPE 316. ALL OTHER STAINLESS STEEL FABRICATIONS SHALL BE TYPE 304 UNLESS NOTED OTHERWISE.

M-7 ALUMINUM SHALL BE ALLOY 6061-T6 UNLESS NOTED OTHERWISE.

M-8 ALL BOLTS, ANCHORS, AND CONCRETE ANCHORS CONNECTING ALUMINUM OR STAINLESS STEEL SHALL BE STAINLESS STEEL TYPE 316 FOR UNDERWATER APPLICATIONS, IN CONFINED AREAS CONTAINING FLUID, AND IN CORROSIVE ENVIRONMENTS AND TYPE 304 FOR ALL OTHER APPLICATIONS.

M-9 ALUMINUM SHALL BE ISOLATED FROM CONTACT WITH CONCRETE AND DISSIMILAR METALS.

M-10 ALL GROOVE AND BUTT WELDS SHALL BE FULL PENETRATION.

M-11 FILLET WELD SIZES SHALL NOT BE LESS THAN THE MINIMUM SIZE REQUIRED BY AISC CODE FOR PLATE SIZES TO BE CONNECTED AND SHALL BE APPLIED TO THE ENTIRE JOINT CONTACT LENGTH, AND NOT LESS THAN 3/16".

M-12 ALL WELDS SHALL BE PERFORMED IN THE SHOP UNLESS NOTED BY A FIELD WELD SYMBOL OR APPROVED BY ENGINEER.

M-13 BOTTOM SURFACES OF BASE PLATES SHALL BE GROUTED TO ENSURE FULL BEARING CONTACT WITH CONCRETE SLAB.

M-14 WHENEVER ONE MEMBER IS FASTENED TO ANOTHER WITH FASTENINGS (BOLTS, WELDS, ETC.) SET AT A UNIFORM SPACING, A MINIMUM OF TWO FASTENINGS PER PIECE SHALL BE CONNECTED AND THE FIRST AND LAST FASTENINGS SHALL BE LOCATED NOT TO EXCEED 0.25 OF FASTENER SPACING FROM EACH END.

M-15 GRATING PANELS SHALL BE CONFINED TO PREVENT MOVEMENT PER STANDARD DETAIL S-05-0706. USE OF GRATING CLIP ATTACHMENT IS NOT ACCEPTABLE TO PREVENT GRATING MOVEMENT.

FOUNDATIONS

F-1 CONCRETE (CAST-IN-PLACE) NOTES APPLY TO FOUNDATIONS.

F-2 ALLOWABLE SOIL BEARING PRESSURE:

STRUCTURE \ PARAMETER	ALLOWABLE SOIL BEARING PRESSURE
SODIUM HYPOCHLORITE FACILITY	1500 PSF

PRECAST CONCRETE

PC-1 PRECAST CONCRETE STRUCTURAL MEMBERS SHALL BE DESIGNED BY A PROFESSIONAL ENGINEER REGISTERED IN THE STATE OF FLORIDA. OPENINGS TO ALLOW VENT PIPES, STRUCTURAL STEEL BRACING AND COLUMNS TO PASS THROUGH SHALL BE PROVIDED.

PC-2 PRECAST CONCRETE VAULTS AND MANHOLES SHALL BE DESIGNED BY A PROFESSIONAL ENGINEER REGISTERED IN THE STATE OF FLORIDA. STRUCTURAL DRAWINGS SHALL INDICATE DESIGN IS IN COMPLIANCE WITH THE FLORIDA BUILDING CODE.

CONCRETE (CAST-IN-PLACE)

C-1 DESIGN OF CONCRETE ELEMENTS INCLUDING WALLS, FORMED SLABS, BEAMS, AND COLUMNS IS IN ACCORDANCE WITH ACI 318 (CODE REQUIREMENTS FOR STRUCTURAL CONCRETE) AND 350 (CODE REQUIREMENTS FOR ENVIRONMENTAL ENGINEERING CONCRETE STRUCTURES).

C-2 CONCRETE STRENGTH CLASSES (28-DAY COMPRESSIVE STRENGTH):

A) CLASS A CONCRETE (4,500 PSI): NORMAL WEIGHT STRUCTURAL CONCRETE IN ALL STRUCTURES, AND FOR ALL SIDEWALKS, CURB AND GUTTERS, AND PAVEMENT.

B) CLASS B CONCRETE (3,000 PSI): NORMAL WEIGHT STRUCTURAL CONCRETE USED FOR DUCT BANK ENCASEMENTS, CATCH BASINS, FENCE AND GUARD POST EMBEDMENT, CONCRETE FILL, AND OTHER AREAS WHERE SPECIFICALLY NOTED ON CONTRACT DRAWINGS.

C-3 ALL BAR REINFORCING SHALL CONFORM TO ASTM A615, GRADE 60 UNLESS NOTED OTHERWISE. WELDED WIRE FABRIC SHALL CONFORM TO ASTM A1064.

C-4 CONCRETE COVER FOR REINFORCING (UNLESS NOTED OTHERWISE ON THE DRAWINGS):

A)	CONCRETE CAST AGAINST EARTH:	3"
B)	FOR CONCRETE SURFACES EXPOSED TO EARTH, LIQUID, OR WEATHER:	
	1) SLABS:	2"
	2) BEAMS AND COLUMNS (TO MAIN REINFORCEMENT): BEAMS AND COLUMNS (TO COLUMN TIES OR STIRRUPS):	2 1/2" 2"
	3) WALLS:	2"
C)	FOR CONCRETE SURFACES NOT EXPOSED TO EARTH, LIQUID, OR WEATHER:	VALUES IN B) ABOVE SHALL BE REDUCED BY 1/2"

C-5 SPLICES SHALL BE CLASS "B" CONFORMING TO THE PROVISIONS OF ACI 318 UNLESS NOTED OTHERWISE. SPLICE LENGTH FOR TWO DIFFERENT SIZED BARS TO BE LAP SPLICED TOGETHER SHALL BE THE LENGTH OF THE LARGER BAR UNLESS NOTED OTHERWISE.

C-6 CONSTRUCTION JOINTS SHALL BE LOCATED AS SHOWN ON THE DRAWINGS. CONSTRUCTION JOINTS NOT SHOWN SHALL BE SUBMITTED BY THE CONTRACTOR FOR THE APPROVAL OF THE ENGINEER PRIOR TO SUBMITTING REBAR SHOP DRAWINGS.

C-7 ALL EXPOSED CORNERS SHALL HAVE A 3/4" CHAMFER.

C-8 EQUIPMENT SUPPORTS, ANCHORAGES, OPENINGS, RECESSES AND REVEALS NOT SHOWN ON THE STRUCTURAL DRAWINGS BUT REQUIRED BY OTHER CONTRACT DOCUMENTS, SHALL BE INSTALLED PRIOR TO PLACING CONCRETE.

C-9 REINFORCING BARS AND ACCESSORIES SHALL NOT BE IN CONTACT WITH ANY METAL PIPE, PIPE FLANGE, METAL CONDUIT, OR OTHER METAL PARTS EMBEDDED IN CONCRETE. A MINIMUM CLEARANCE OF 2" SHALL BE PROVIDED.

C-10 CONDUITS AND OTHER SIMILAR ITEMS EMBEDDED IN OR PENETRATING THROUGH CONCRETE SHALL BE SPACED ON CENTER NOT LESS THAN 3 TIMES THEIR OUTSIDE DIMENSION, BUT NOT LESS THAN 2 1/2" CLEAR. WHEN SUCH ITEMS ARE EMBEDDED IN WALLS OR SLABS, THEY SHALL NOT OCCUPY MORE THAN 1/3 OF THE MEMBER THICKNESS.

C-11 AT ALL EQUIPMENT PADS AND PIPE SUPPORT PIERS, REINFORCING DOWELS SHOWN MAY BE REPLACED WITH ADHESIVE DOWELS AS SPECIFIED. DOWELS LOCATED CLOSER THAN 3" FROM ANY EDGE OF CONCRETE SHALL NOT BE REPLACED WITH DRILLED DOWELS.

C-12 ADJUST THE LOCATION OF DOWELS OR ANCHORS PLACED INTO HARDENED CONCRETE AS NEEDED TO AVOID DRILLING THROUGH ANY REINFORCING BARS. IF THE LOCATION NEEDS TO BE MODIFIED, CONTACT THE ENGINEER. CONTRACTOR SHALL USE NON-DESTRUCTIVE MEANS TO FIELD LOCATE REINFORCEMENT PRIOR TO DRILLING HOLES FOR DOWELS OR ANCHORS.

C-13 CLEAR DISTANCE FROM ANCHOR RODS TO ANY CONCRETE EDGE SHALL BE 4" MINIMUM UNLESS NOTED OTHERWISE.

NONSTRUCTURAL COMPONENT ANCHORAGE AND BRACING

A-1 ANCHORAGE AND BRACING SHALL BE PROVIDED FOR NONSTRUCTURAL COMPONENTS IN ACCORDANCE WITH SPECIFICATION 01 73 23 - ANCHORAGE AND BRACING OF NONSTRUCTURAL COMPONENTS. "NONSTRUCTURAL COMPONENTS" INCLUDES ALL ARCHITECTURAL, MECHANICAL, ELECTRICAL, AND PLUMBING ELEMENTS OR SYSTEMS (AND THEIR SUPPORTS OR ATTACHMENTS) WHICH ARE PERMANENTLY ATTACHED TO A SUPPORTING STRUCTURE. DESIGN OF ANCHORAGE AND BRACING SHALL BE PROVIDED BY CONTRACTOR'S ENGINEER UNLESS SPECIFICALLY DETAILED ON THE CONTRACT DRAWINGS.

A-2 ANCHORAGE AND BRACING OF ALL NONSTRUCTURAL COMPONENTS SHALL BE DESIGNED AND INSTALLED TO RESIST THE CONTROLLING LOAD COMBINATION OF GRAVITY LOADS, OPERATIONAL FORCES, WIND FORCES, SEISMIC FORCES, AND ANY OTHER APPLICABLE FORCES IN ACCORDANCE WITH THE GOVERNING BUILDING CODE. WIND FORCES SHALL BE AS PER ASCE 7. COMPONENTS SHALL BE BOLTED, WELDED, OR OTHERWISE POSITIVELY FASTENED WITHOUT CONSIDERATION OF FRICTIONAL RESISTANCE PRODUCED BY THE EFFECTS OF GRAVITY. A CONTINUOUS LOAD PATH OF SUFFICIENT STRENGTH AND STIFFNESS TO RESIST REQUIRED FORCES SHALL BE PROVIDED BETWEEN THE COMPONENT AND THE SUPPORTING STRUCTURE. ANCHORAGE AND BRACING SHALL BE DESIGNED TO RESIST LOADS IN BOTH ORTHOGONAL DIRECTIONS (TRANSVERSE AND LONGITUDINAL) AND SHALL BE DESIGNED AND SEALED BY THE CONTRACTOR'S ENGINEER CURRENTLY REGISTERED IN THE STATE OF FLORIDA.

A-3 COMPONENT REACTION FORCES AT THE POINT OF ATTACHMENT TO THE STRUCTURE SHALL BE SUBMITTED TO AND COORDINATED WITH THE ENGINEER FOR CONFIRMATION THAT SUPPORTING STRUCTURE IS ADEQUATE TO RESIST REQUIRED REACTION FORCES.

SPECIAL INSPECTIONS

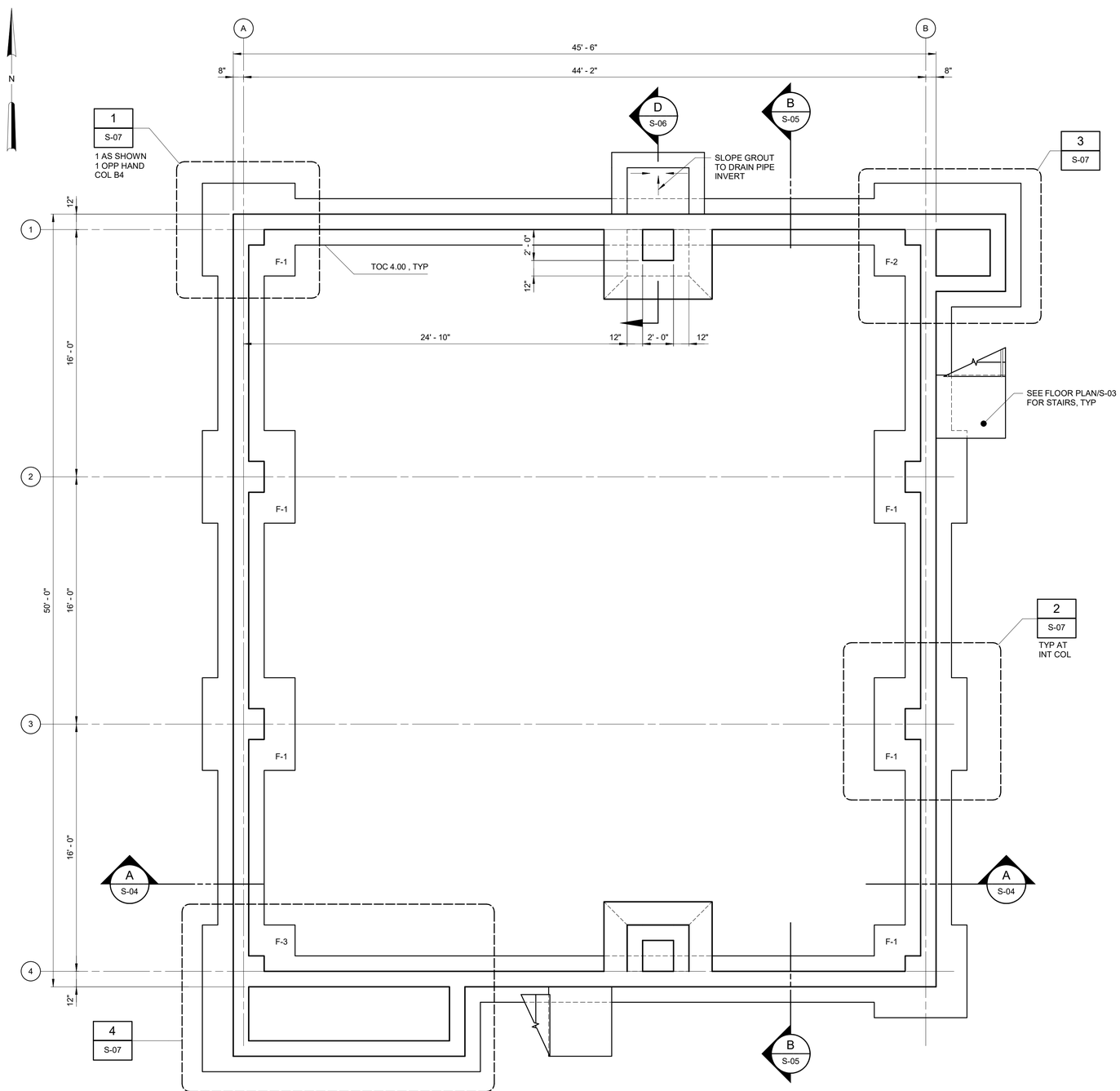
SI-1 SPECIAL INSPECTIONS SHALL BE IN ACCORDANCE WITH SPECIFICATIONS AND THE FLORIDA BUILDING CODE.

DELEGATED STRUCTURAL DESIGN ITEMS

DSD-1 THE FOLLOWING ITEMS SHALL BE SUBMITTED AS DELEGATED STRUCTURAL DESIGNS DURING CONSTRUCTION, IN ACCORDANCE WITH THE CONTRACT DRAWINGS AND SPECIFICATIONS.

A. PRE-ENGINEERED METAL BUILDINGS
B. ANCHORAGE AND BRACING OF NONSTRUCTURAL COMPONENTS NOT SPECIFICALLY DESIGNED AND DETAILED ON THE CONTRACT DRAWINGS (INCLUDING, BUT NOT LIMITED TO, PIPE SUPPORTS AND EQUIPMENT)

DSD-2 DRAWINGS AND CALCULATIONS FOR EACH ITEM SHALL BE SIGNED AND SEALED BY A PROFESSIONAL ENGINEER REGISTERED IN THE STATE OF FLORIDA.



FOUNDATION PLAN
1/4" = 1'-0"

NOTES:

1. THE SODIUM HYPOCHLORITE FACILITY CANOPY SHALL BE A PRE-ENGINEERED METAL BUILDING PER SPECIFICATION SECTION 13 34 19. METAL BUILDING DESIGN CALCULATIONS AND DETAILED DRAWINGS SHALL BE SIGNED AND SEALED BY A PROFESSIONAL ENGINEER REGISTERED IN THE STATE OF FLORIDA.
2. THE PRE-ENGINEERED METAL BUILDING FOUNDATION SHALL BE AS SHOWN ON THE CONTRACT DOCUMENTS. THE CONTRACTOR SHALL COORDINATE ANCHOR ROD REQUIREMENTS WITH METAL BUILDING MANUFACTURER AND THE ENGINEER. THE ENGINEER SHALL VERIFY THE FOUNDATION CAPACITY FOR THE REACTIONS PROVIDED BY THE PRE-ENGINEERED METAL BUILDING MANUFACTUER. FOUNDATION DIMENSIONS SHOWN ARE FOR BIDDING PURPOSES AND MAY VARY DEPENDING ON MANUFACTURER SELECTED. FINAL DIMENSIONS SHALL BE VERIFIED AFTER PRE-ENGINEERED METAL BUILDING MANUFACTURER'S FINAL DESIGN HAS BEEN APPROVED.
3. A MINIMUM OF FOUR ANCHOR RODS WITH 18 INCH MINIMUM EMBEDMENT SHALL BE PROVIDED FOR ALL COLUMNS. THE ENGINEER SHALL CONFIRM ANCHOR ROD EMBEDMENT REQUIREMENTS AFTER COLUMNS REACTIONS LOADS ARE PROVIDED.
4. PRE-ENGINEERED METAL BUILDING SYSTEM SHALL BE DESIGNED PER THE FLORIDA BUILDING CODE AND LIVE LOADS SHOWN IN THE GENERAL STRUCTURAL NOTES.
5. PRE-ENGINEERED METAL BUILDING MANUFACTURER SHALL PROVIDE A SUPPORT BEAM FOR CHEMICAL PIPING OVERHEAD SUPPORT SYSTEM. BEAM SHALL BE CAPABLE OF SUPPORTING TWO POINT LOADS OF 100 LB EACH.

REV	ISSUED FOR	DATE	BY

PROJECT ENGINEER:	J. BOWDEN
DESIGNED BY:	J. SILVA
DRAWN BY:	E. McCLELLAN
CHECKED BY:	J. SILVA

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE 0 1/2" 1"

Hazen
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4000 HOLLYWOOD BLVD SUITE 750N
HOLLYWOOD, FL 33021

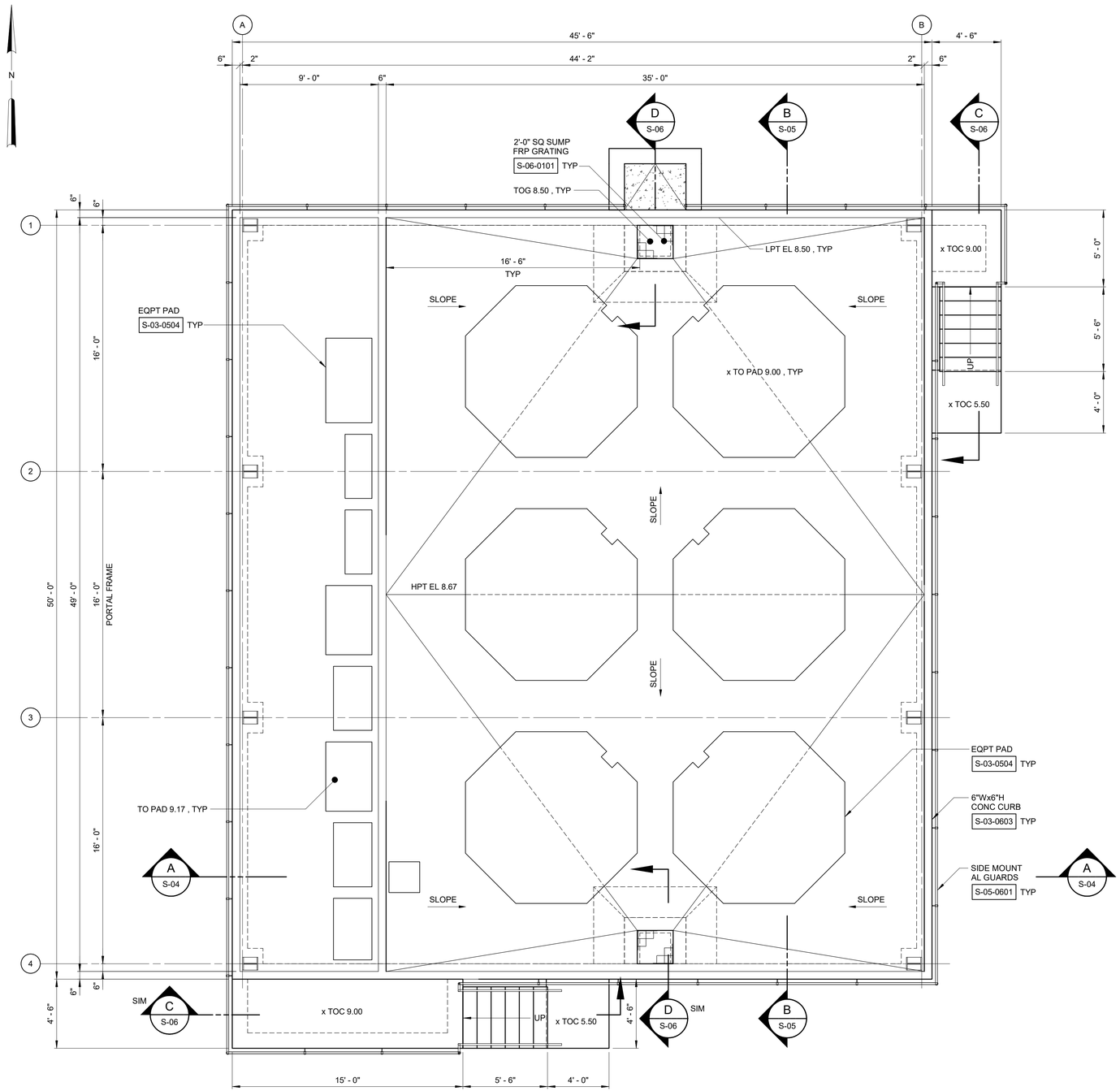
CITY OF HOLLYWOOD
HOLLYWOOD, FLORIDA

SODIUM HYPOCHLORITE
TEMPORARY STORAGE AND FEED SYSTEM

STRUCTURAL
TEMPORARY HYPOCHLORITE SYSTEM
FOUNDATION PLAN

DATE:	DECEMBER 2025
PROJECT NO.:	4321-111
CONTRACT NO.:	22-8073
DRAWING NUMBER:	S-02

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NOTES:

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2. THE PRE-ENGINEERED METAL BUILDING FOUNDATION SHALL BE AS SHOWN ON THE CONTRACT DOCUMENTS. THE CONTRACTOR SHALL COORDINATE ANCHOR ROD REQUIREMENTS WITH METAL BUILDING MANUFACTURER AND THE ENGINEER. THE ENGINEER SHALL VERIFY THE FOUNDATION CAPACITY FOR THE REACTIONS PROVIDED BY THE PRE-ENGINEERED METAL BUILDING MANUFACTUER. FOUNDATION DIMENSIONS SHOWN ARE FOR BIDDING PURPOSES AND MAY VARY DEPENDING ON MANUFACTURER SELECTED. FINAL DIMENSIONS SHALL BE VERIFIED AFTER PRE-ENGINEERED METAL BUILDING MANUFACTURER'S FINAL DESIGN HAS BEEN APPROVED.
3. A MINIMUM OF FOUR ANCHOR RODS WITH 18 INCH MINIMUM EMBEDMENT SHALL BE PROVIDED FOR ALL COLUMNS. THE ENGINEER SHALL CONFIRM ANCHOR ROD EMBEDMENT REQUIREMENTS AFTER COLUMNS REACTIONS LOADS ARE PROVIDED.
4. PRE-ENGINEERED METAL BUILDING SYSTEM SHALL BE DESIGNED PER THE FLORIDA BUILDING CODE AND LIVE LOADS SHOWN IN THE GENERAL STRUCTURAL NOTES.
5. FLOOR SLOPE SHALL BE 1/8" PER FOOT MAXIMUM, UNO.

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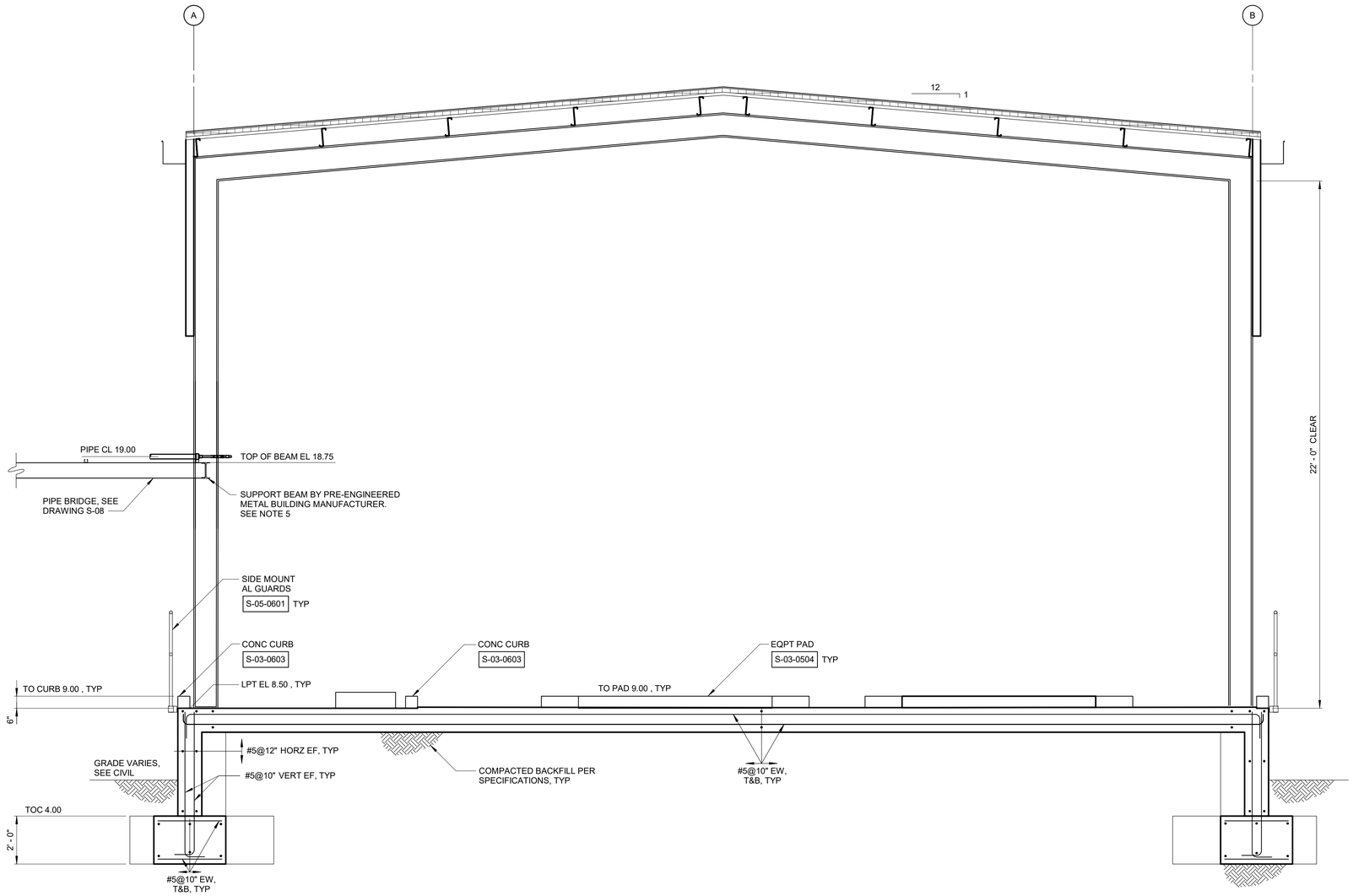
CITY OF HOLLYWOOD
HOLLYWOOD, FLORIDA

SODIUM HYPOCHLORITE
TEMPORARY STORAGE AND FEED SYSTEM

STRUCTURAL
TEMPORARY HYPOCHLORITE SYSTEM
FLOOR PLAN

DATE:	DECEMBER 2025
PROJECT NO.:	4321-111
CONTRACT NO.:	22-8073
DRAWING NUMBER:	S-03

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SECTION A
3/8" = 1'-0"
S-02

NOTES:

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4. PRE-ENGINEERED METAL BUILDING SYSTEM SHALL BE DESIGNED PER THE FLORIDA BUILDING CODE AND LIVE LOADS SHOWN IN THE GENERAL STRUCTURAL NOTES.
5. PRE-ENGINEERED METAL BUILDING MANUFACTURER SHALL PROVIDE A SUPPORT BEAM FOR CHEMICAL PIPING OVERHEAD SUPPORT SYSTEM. BEAM SHALL BE CAPABLE OF SUPPORTING TWO POINT LOADS OF 100 LB EACH.

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HOLLYWOOD, FLORIDA

SODIUM HYPOCHLORITE
TEMPORARY STORAGE AND FEED SYSTEM

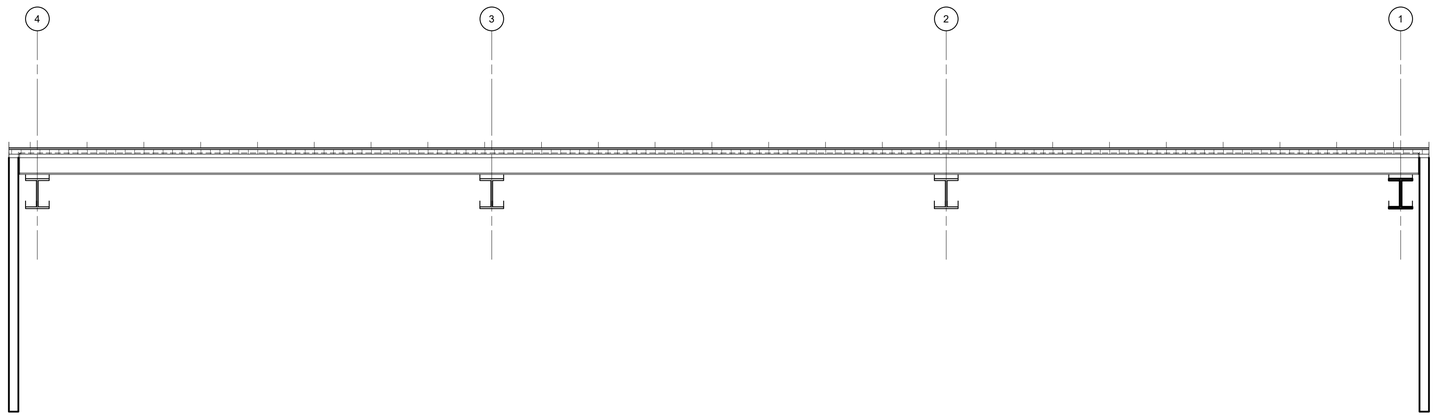
STRUCTURAL
TEMPORARY HYPOCHLORITE SYSTEM
SECTIONS - I

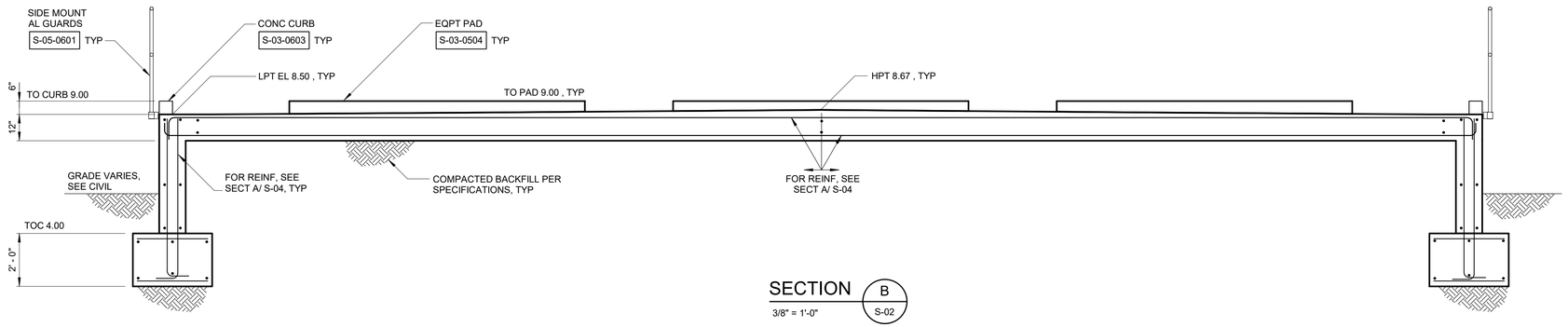
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NOTES:

1. THE SODIUM HYPOCHLORITE FACILITY CANOPY SHALL BE A PRE-ENGINEERED METAL BUILDING PER SPECIFICATION SECTION 13 34 19. METAL BUILDING DESIGN CALCULATIONS AND DETAILED DRAWINGS SHALL BE SIGNED AND SEALED BY A PROFESSIONAL ENGINEER REGISTERED IN THE STATE OF FLORIDA.
2. THE PRE-ENGINEERED METAL BUILDING FOUNDATION SHALL BE AS SHOWN ON THE CONTRACT DOCUMENTS. THE CONTRACTOR SHALL COORDINATE ANCHOR ROD REQUIREMENTS WITH METAL BUILDING MANUFACTURER AND THE ENGINEER. THE ENGINEER SHALL VERIFY THE FOUNDATION CAPACITY FOR THE REACTIONS PROVIDED BY THE PRE-ENGINEERED METAL BUILDING MANUFACTUER. FOUNDATION DIMENSIONS SHOWN ARE FOR BIDDING PURPOSES AND MAY VARY DEPENDING ON MANUFACTURER SELECTED. FINAL DIMENSIONS SHALL BE VERIFIED AFTER PRE-ENGINEERED METAL BUILDING MANUFACTURER'S FINAL DESIGN HAS BEEN APPROVED.
3. A MINIMUM OF FOUR ANCHOR RODS WITH 18 INCH MINIMUM EMBEDMENT SHALL BE PROVIDED FOR ALL COLUMNS. THE ENGINEER SHALL CONFIRM ANCHOR ROD EMBEDMENT REQUIREMENTS AFTER COLUMNS REACTIONS LOADS ARE PROVIDED.
4. PRE-ENGINEERED METAL BUILDING SYSTEM SHALL BE DESIGNED PER THE FLORIDA BUILDING CODE AND LIVE LOADS SHOWN IN THE GENERAL STRUCTURAL NOTES.
5. PRE-ENGINEERED METAL BUILDING MANUFACTURER SHALL PROVIDE A SUPPORT BEAM FOR CHEMICAL PIPING OVERHEAD SUPPORT SYSTEM. BEAM SHALL BE CAPABLE OF SUPPORTING TWO POINT LOADS OF 100 LB EACH.





SECTION B / S-02
3/8" = 1'-0"

REV	ISSUED FOR	DATE	BY

PROJECT ENGINEER:	J. BOWDEN
DESIGNED BY:	J. SILVA
DRAWN BY:	E. McCLELLAN
CHECKED BY:	J. SILVA
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE	0 1/2" 1"

Hazen
HAZEN AND SAWYER
4000 HOLLYWOOD BLVD SUITE 750N
HOLLYWOOD, FL 33021

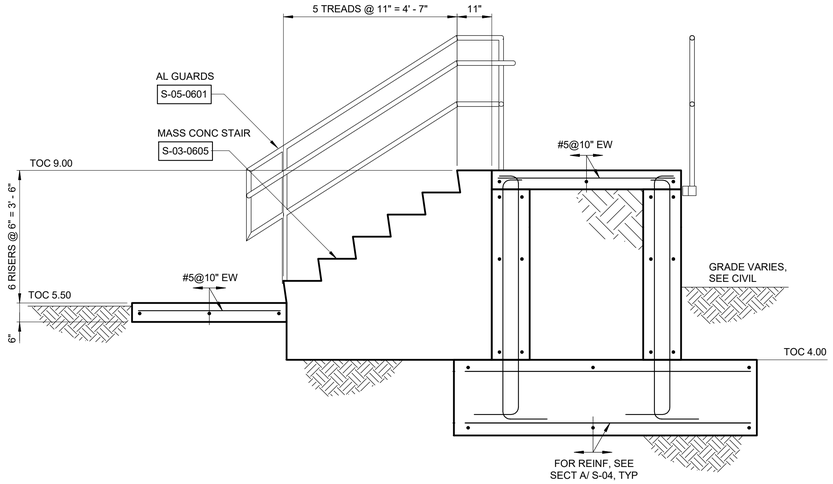
CITY OF HOLLYWOOD
HOLLYWOOD, FLORIDA

SODIUM HYPOCHLORITE
TEMPORARY STORAGE AND FEED SYSTEM

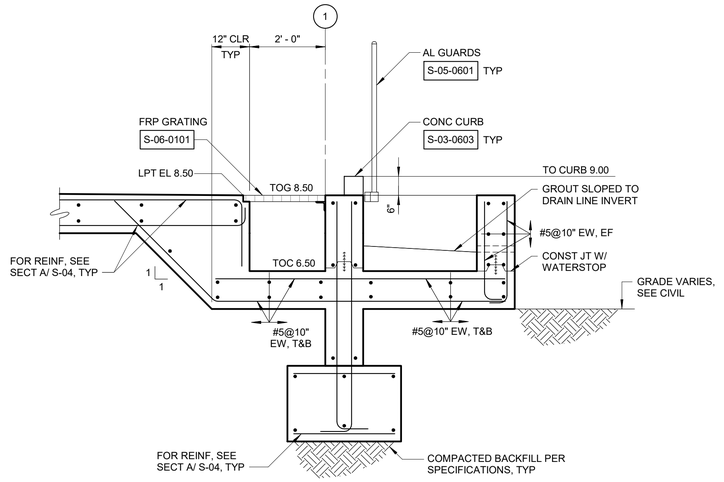
STRUCTURAL
TEMPORARY HYPOCHLORITE SYSTEM
SECTIONS - II

DATE:	DECEMBER 2025
PROJECT NO.:	4321-111
CONTRACT NO.:	22-8073
DRAWING NUMBER:	S-05

Autodesk Docs://04321-111/04321-111-100-S.rvt
8/25/2025 11:41:55 AM



SECTION C
1/2" = 1'-0"
S-03



SECTION D
1/2" = 1'-0"
S-02

REV	ISSUED FOR	DATE	BY

PROJECT ENGINEER:	J. BOWDEN
DESIGNED BY:	J. SILVA
DRAWN BY:	E. McCLELLAN
CHECKED BY:	J. SILVA

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE 0 1/2" 1"

Hazen
HAZEN AND SAWYER
4000 HOLLYWOOD BLVD SUITE 750N
HOLLYWOOD, FL 33021

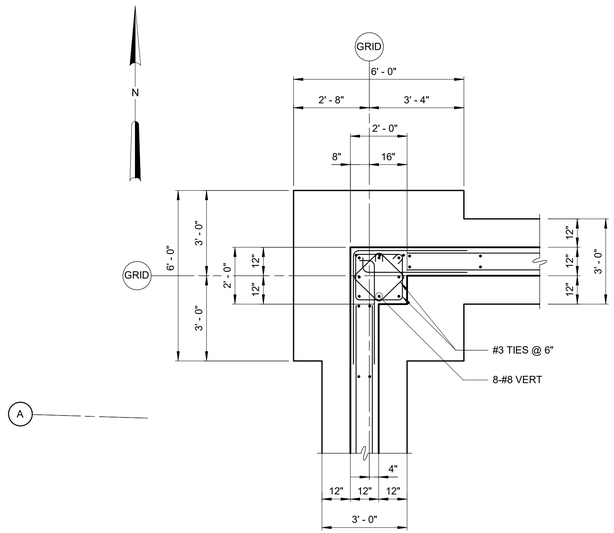
CITY OF HOLLYWOOD
HOLLYWOOD, FLORIDA

SODIUM HYPOCHLORITE
TEMPORARY STORAGE AND FEED SYSTEM

STRUCTURAL
TEMPORARY HYPOCHLORITE SYSTEM
SECTIONS - III

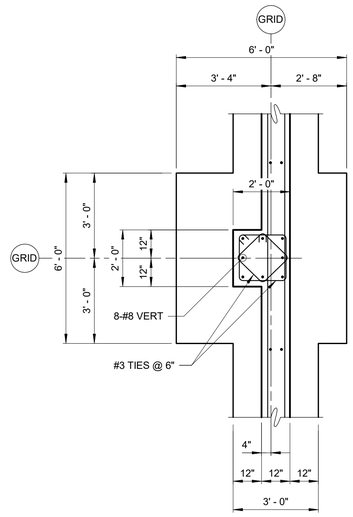
DATE:	DECEMBER 2025
PROJECT NO.:	4321-111
CONTRACT NO.:	22-8073
DRAWING NUMBER:	S-06

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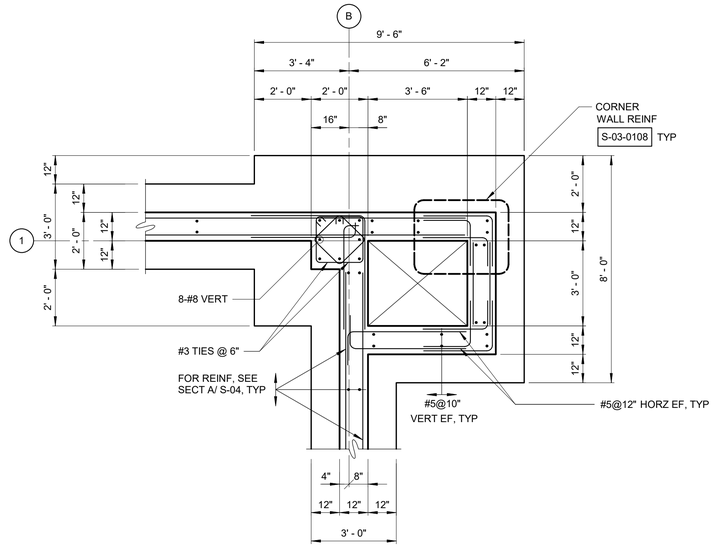
DETAIL 1

3/8" = 1'-0" S-02



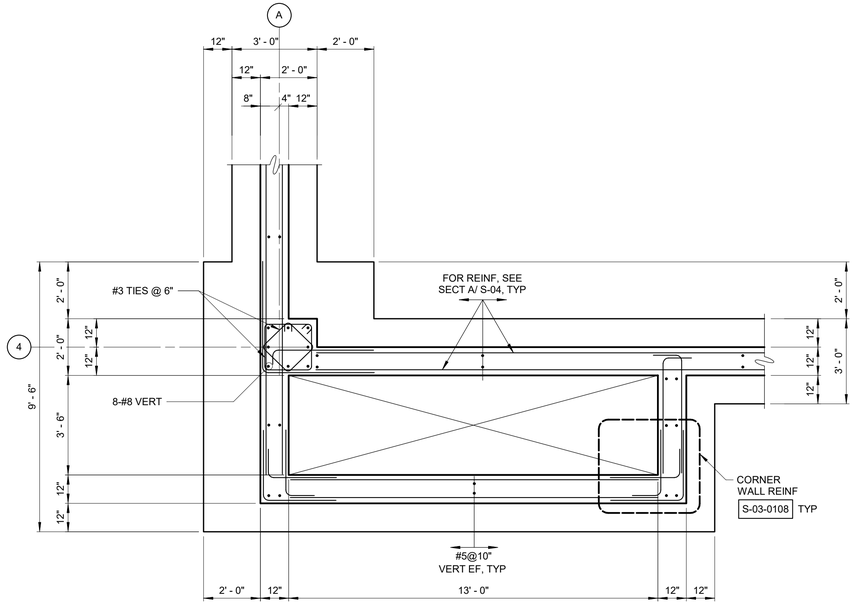
DETAIL 2

3/8" = 1'-0" S-02



DETAIL 3

3/8" = 1'-0" S-02



DETAIL 4

3/8" = 1'-0" S-02

FOOTING SCHEDULE					
MARK	SIZE			REINF	
	LENGTH	WIDTH	THICK	TOP	BOTTOM
F-1	6'-0"	6'-0"	2'-0"	#5@10" EW	#5@10" EW
F-2	VARIES, SEE DETAILS		2'-0"	#5@10" EW	#5@10" EW
F-3	VARIES, SEE DETAILS		2'-0"	#5@10" EW	#5@10" EW

REV	ISSUED FOR	DATE	BY

PROJECT ENGINEER:	J. BOWDEN
DESIGNED BY:	J. SILVA
DRAWN BY:	E. McCLELLAN
CHECKED BY:	J. SILVA

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE 0 1/2" 1"

Hazen

HAZEN AND SAWYER
4000 HOLLYWOOD BLVD SUITE 750N
HOLLYWOOD, FL 33021

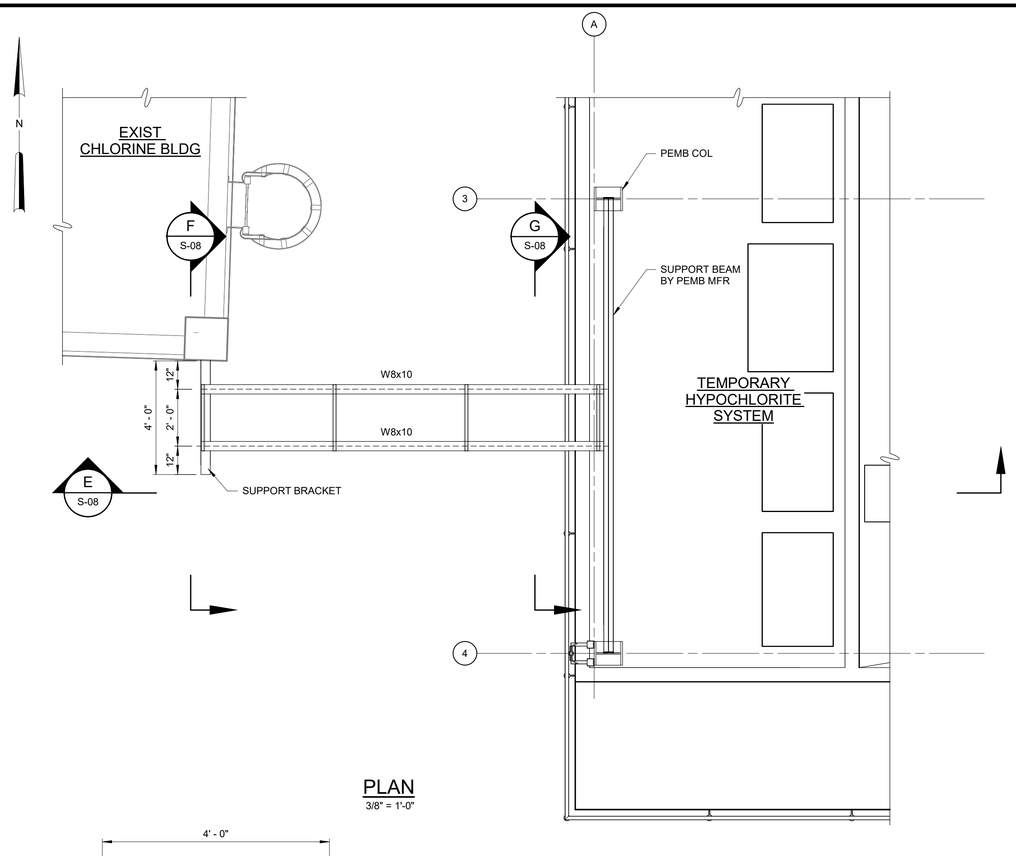
CITY OF HOLLYWOOD
HOLLYWOOD, FLORIDA

SODIUM HYPOCHLORITE
TEMPORARY STORAGE AND FEED SYSTEM

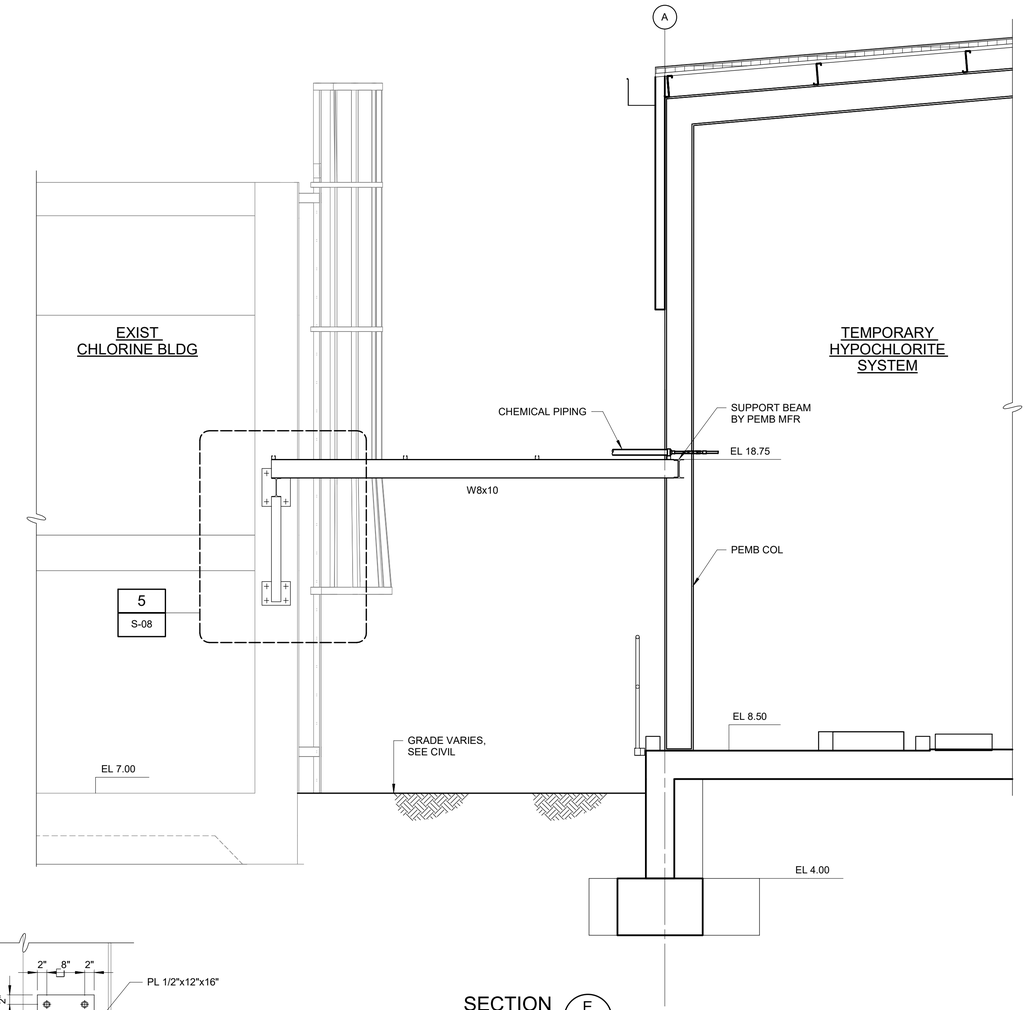
STRUCTURAL
TEMPORARY HYPOCHLORITE SYSTEM
DETAILS - I

DATE:	DECEMBER 2025
PROJECT NO.:	4321-111
CONTRACT NO.:	22-8073
DRAWING NUMBER:	S-07

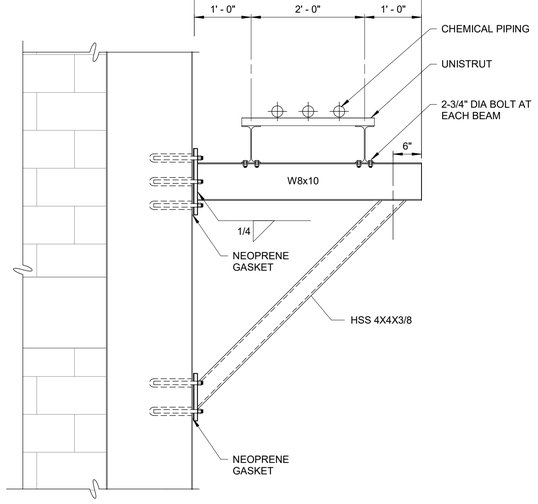
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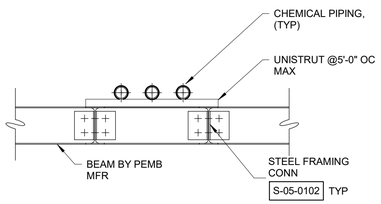
PLAN
3/8" = 1'-0"



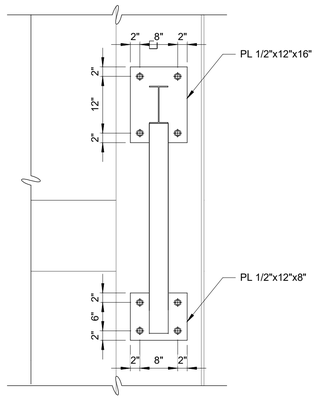
SECTION E
3/8" = 1'-0" — S-08



SECTION F
3/4" = 1'-0" — S-08



SECTION G
3/4" = 1'-0" — S-08



DETAIL 5
3/4" = 1'-0" — S-08

REV	ISSUED FOR	DATE	BY

PROJECT ENGINEER:	J. BOWDEN
DESIGNED BY:	J. SILVA
DRAWN BY:	G. BUITRAGO
CHECKED BY:	J. SILVA

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE — 0 1/2" 1"

Hazen
HAZEN AND SAWYER
4000 HOLLYWOOD BLVD SUITE 750N
HOLLYWOOD, FL 33021

CITY OF HOLLYWOOD
HOLLYWOOD, FLORIDA

SODIUM HYPOCHLORITE
TEMPORARY STORAGE AND FEED SYSTEM

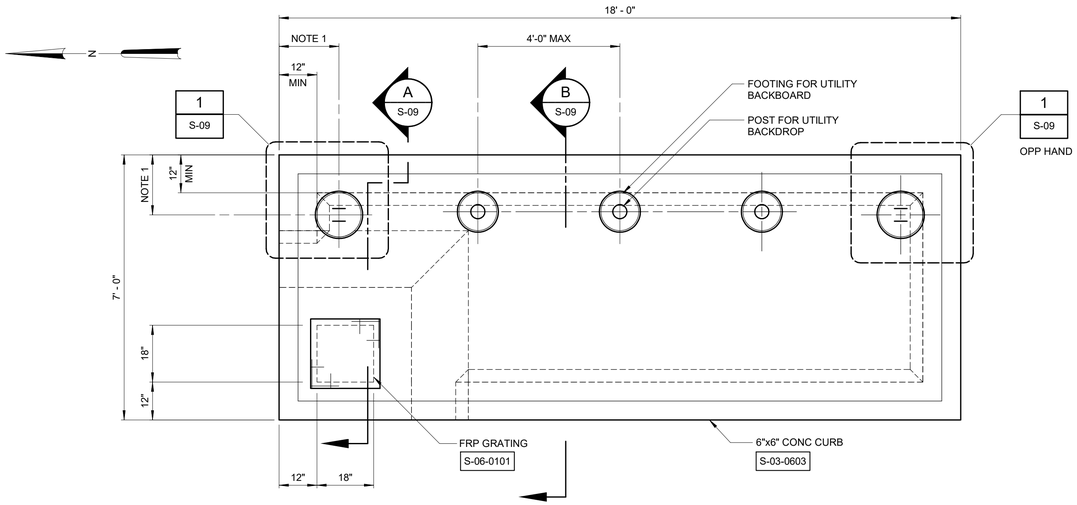
STRUCTURAL
TEMPORARY HYPOCHLORITE SYSTEM
PIPE BRIDGE DETAILS

DATE:	DECEMBER 2025
PROJECT NO.:	4321-111
CONTRACT NO.:	22-8073
DRAWING NUMBER:	S-08

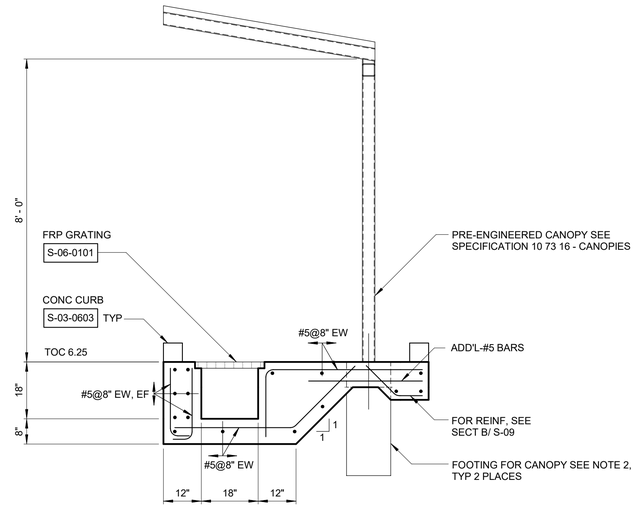
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NOTES:

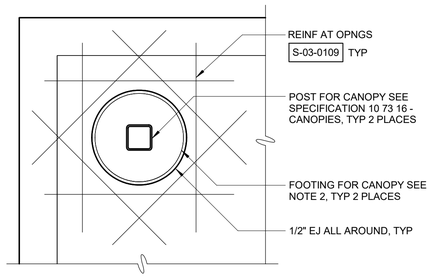
1. LOCATE CANOPY FOOTING TO ALLOW AT LEAST 12 INCHES EDGE DISTANCE BETWEEN FOOTING AND EDGE OF SLAB.
2. CANOPY FOOTING SHALL BE DESIGNED BY CANOPY MANUFACTURER. SUBMIT CALCULATIONS SIGNED AND SEALED BY A PROFESSIONAL ENGINEER REGISTERED IN THE STATE OF FLORIDA.



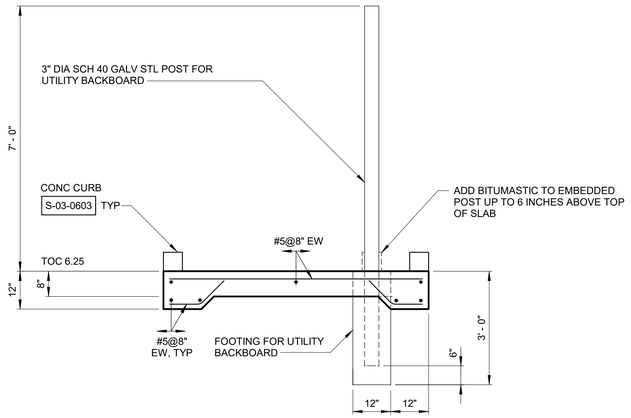
FOUNDATION PLAN
1/2" = 1'-0"



SECTION A
1/2" = 1'-0" — A S-09



DETAIL 1
1" = 1'-0" — S-09



SECTION B
1/2" = 1'-0" — B S-09

REV	ISSUED FOR	DATE	BY

PROJECT ENGINEER:	J. BOWDEN
DESIGNED BY:	J. SILVA
DRAWN BY:	E. McCLELLAN
CHECKED BY:	J. SILVA

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE — 0 1/2" 1"

Hazen
HAZEN AND SAWYER
4000 HOLLYWOOD BLVD SUITE 750N
HOLLYWOOD, FL 33021

CITY OF HOLLYWOOD
HOLLYWOOD, FLORIDA

SODIUM HYPOCHLORITE
TEMPORARY STORAGE AND FEED SYSTEM

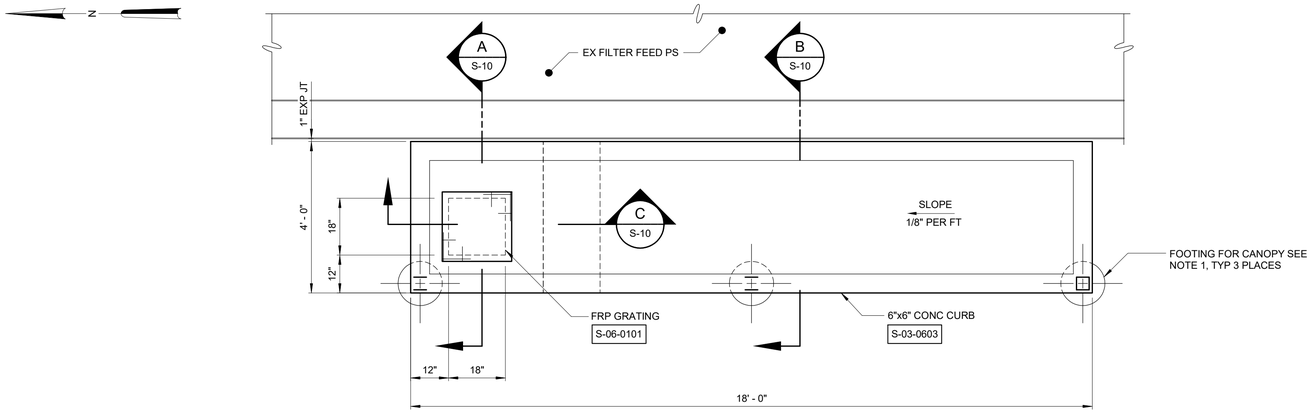
STRUCTURAL
NaOCl INJECTION DOSING STATION FOR REUSE CCT & NON-POTABLE CCT DETAILS

DATE:	DECEMBER 2025
PROJECT NO.:	4321-111
CONTRACT NO.:	22-8073
DRAWING NUMBER:	S-09

Autodesk Docs://04321-111/04321-111-200-INJ-S.rvt
8/25/2025 12:05:16 PM

NOTES:

1. CANOPY FOOTING SHALL BE DESIGNED BY CANOPY MANUFACTURER. SUBMIT CALCULATIONS SIGNED AND SEALED BY A PROFESSIONAL ENGINEER REGISTERED IN THE STATE OF FLORIDA.



FOUNDATION PLAN

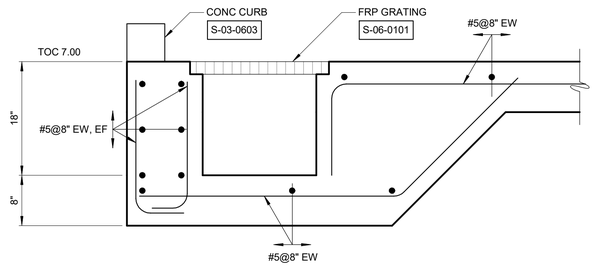
1/2" = 1'-0"

SECTION A

1/2" = 1'-0" — S-10

SECTION B

1/2" = 1'-0" — S-10



SECTION C

1" = 1'-0" — S-10

REV	ISSUED FOR	DATE	BY

PROJECT ENGINEER:	J. BOWDEN
DESIGNED BY:	J. SILVA
DRAWN BY:	E. McCLELLAN
CHECKED BY:	J. SILVA

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE — 0 1/2" 1"

Hazen

HAZEN AND SAWYER
4000 HOLLYWOOD BLVD SUITE 750N
HOLLYWOOD, FL 33021

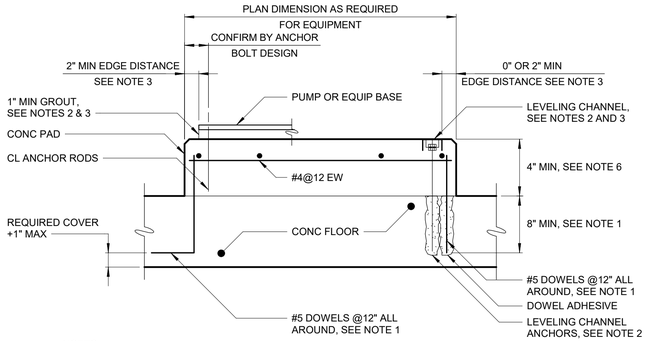
CITY OF HOLLYWOOD
HOLLYWOOD, FLORIDA

SODIUM HYPOCHLORITE
TEMPORARY STORAGE AND FEED SYSTEM

STRUCTURAL
NaOCl INJECTION DOSING STATION FOR HYDRAULIC BOX & INJECTION DIVERSION DETAILS

DATE:	DECEMBER 2025
PROJECT NO.:	4321-111
CONTRACT NO.:	22-8073
DRAWING NUMBER:	S-10

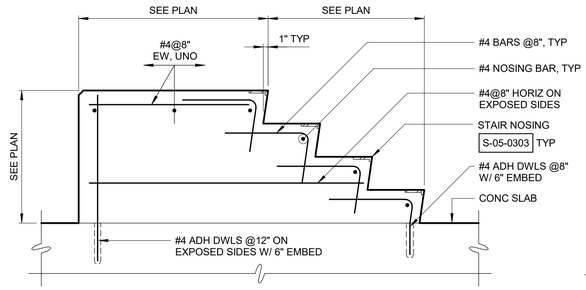
Autodesk Docs://04321-111/04321-111-300-INJ-S.rvt
8/25/2025 11:54:21 AM



NOTES:
1. DOWELS MAY BE CAST IN WITH 90° HOOK OR ANCHORED WITH DOWEL ADHESIVE AT CONTRACTORS OPTION. WHERE FLOOR IS LESS THAN 10" THICK, USE #4 DOWELS EMBEDDED TO WITHIN 2" OF BOTTOM OF FLOOR SLAB.
2. THE CONTRACTOR SHALL PROVIDE LEVELING CHANNELS AND LEVELING CHANNEL ANCHORS FOR SWITCHGEAR, SWITCHBOARDS, MOTOR CONTROL CENTERS, AND SIMILAR EQUIPMENT WHEN REQUIRED TO MEET EQUIPMENT MANUFACTURER'S LEVELING TOLERANCES. THE CONTRACTOR SHALL PROVIDE 1" MINIMUM GROUT FOR PUMPS AND SIMILAR EQUIPMENT WHEN REQUIRED TO MEET EQUIPMENT MANUFACTURER'S UNIFORM BEARING AND LEVELING REQUIREMENTS. GROUT BELOW BASE PLATE SHALL BE AS STIPULATED IN SPECIFICATION 03 60 00, UNLESS OTHERWISE RECOMMENDED BY MANUFACTURER OF EQUIPMENT.
3. PRIOR TO PLACING CONCRETE PAD, LEVELING CHANNEL SIZE AND MEANS OF INSTALLATION, ANCHORAGE, GROUT, CONCRETE EDGE DISTANCE, AND CONCRETE BLOCKOUTS REQUIREMENTS SHALL BE COORDINATED WITH EQUIPMENT MANUFACTURER.
4. COAT DISSIMILAR MATERIALS PER THE CONTRACT DOCUMENTS.
5. STAGGER CHANNEL ANCHORS AND PAD DOWELS.
6. FOR PADS 24" OR GREATER IN DEPTH, PROVIDE #4@8" HORIZONTAL SKIN REINFORCING AROUND PERIMETER OF PAD.

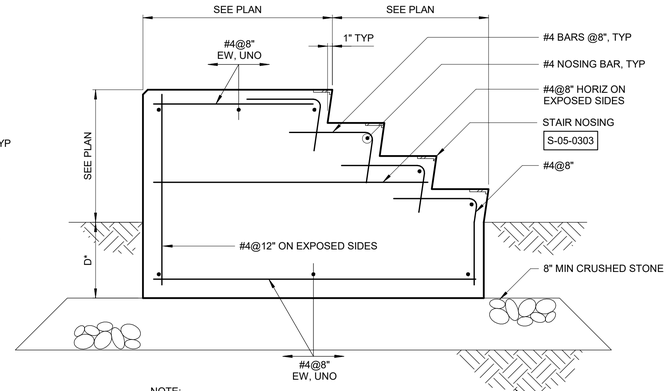
EQUIPMENT PAD

S-03-0504



NOTE: GUARDS NOT SHOWN, SEE PLAN.

MASS CONCRETE STAIR ON SLAB

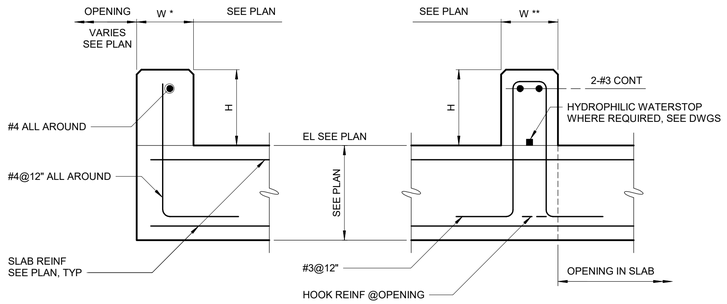


NOTE:
1. GUARDS NOT SHOWN, SEE PLAN.
2. * MINIMUM DEPTH FROM FINISHED GRADE TO BOTTOM OF FOUNDATION PER GENERAL STRUCTURAL NOTES (FROST DEPTH)

MASS CONCRETE STAIR

S-03-0605

ISOLATED MASS CONCRETE STAIR



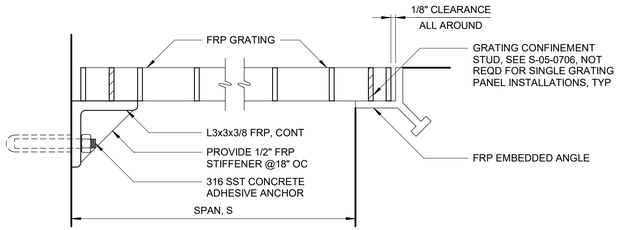
NOTE:
1. W* DENOTES CURBS LESS THAN 8"
2. W** DENOTES CURBS EQUAL TO OR GREATER THAN 8".
3. DOWELS INTO BEAMS SHALL BE CAST IN UNLESS APPROVED BY ENGINEER. ALL OTHER DOWELS MAY BE CAST IN OR ANCHORED WITH DOWEL ADHESIVE SYSTEM WITH A 6" MINIMUM EMBEDMENT.
4. WHERE FLOOR IS 8" THICK OR LESS, USE DOWELS EMBEDDED TO WITHIN 2" OF BOTTOM OF FLOOR SLAB.

CONCRETE CURB

S-03-0603

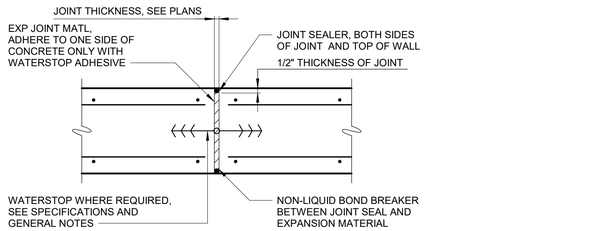
SPAN, S	DEPTH (MIN)	CONCRETE ANCHOR (SIZE AND SPACING)
0'-0" < S ≤ 3'-6"	1 1/2"	1/2"∅x5 1/2" @ 18"
3'-6"< S ≤ 5'-0"	2"	5/8"∅x6" @ 18"

SCHEDULE BASED ON 150 PSF



FRP GRATING

S-06-0101



EXPANSION JOINT

S-03-0201

REV	ISSUED FOR	DATE	BY

PROJECT ENGINEER:	J. BOWDEN
DESIGNED BY:	J. SILVA
DRAWN BY:	E. McCLELLAN
CHECKED BY:	J. SILVA

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE — 0 1/2" 1"

Hazen
HAZEN AND SAWYER
4000 HOLLYWOOD BLVD SUITE 750N
HOLLYWOOD, FL 33021

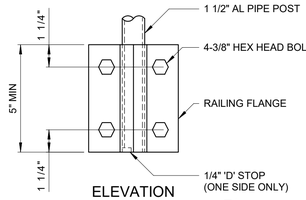
CITY OF HOLLYWOOD
HOLLYWOOD, FLORIDA

SODIUM HYPOCHLORITE
TEMPORARY STORAGE AND FEED SYSTEM

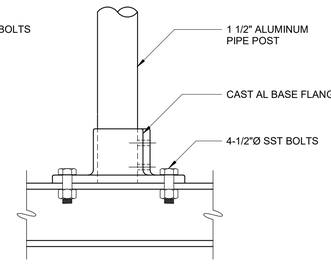
STRUCTURAL
TYPICAL DETAILS
SHEET 1

DATE:	DECEMBER 2025
PROJECT NO.:	4321-111
CONTRACT NO.:	22-8073
DRAWING NUMBER:	S-11

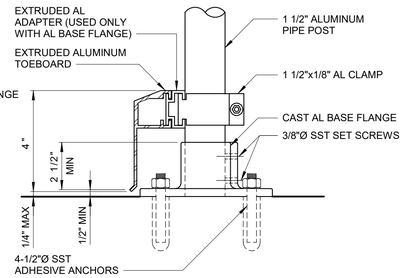
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8/25/2025 11:54:39 AM



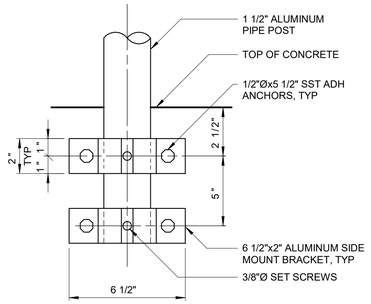
SIDE MOUNT TO METAL



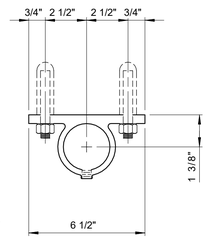
SURFACE MOUNTED TO METAL



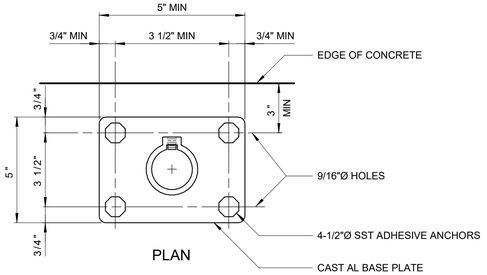
SURFACE MOUNTED TO CONCRETE



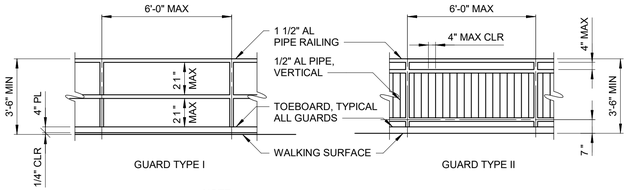
SIDE MOUNT TO CONCRETE



PLAN

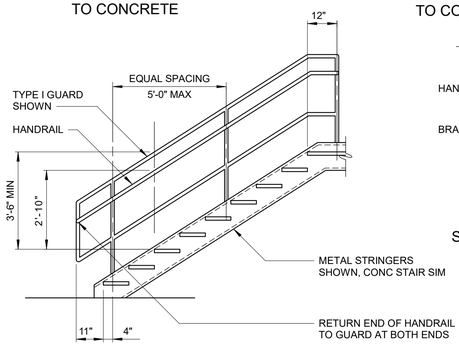


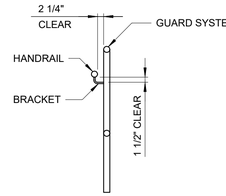
PLAN



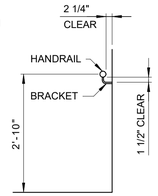
NOTE:
UNLESS SHOWN OTHERWISE ON THE
CONTRACT DRAWING, GUARDS SHALL BE TYPE I.

ELEVATION

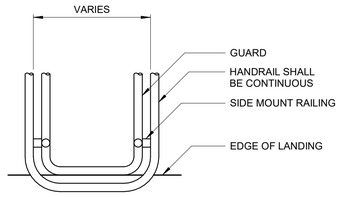




STAIR GUARD SECTION



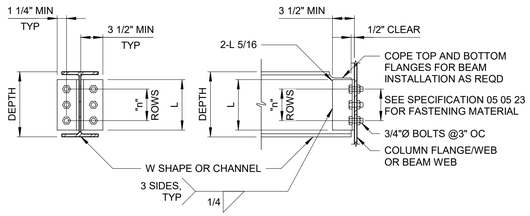
WALL HANDRAIL



TYPICAL STAIR HANDRAIL TURN

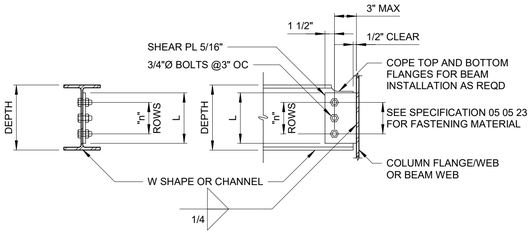
NOTE:
DESIGN OF GUARDS AND HANDRAIL SYSTEMS IS EXCLUSIVELY THE RESPONSIBILITY OF THE CONTRACTOR. DETAILS SHOWN ARE MINIMUM REQUIREMENTS FOR MEMBERS AND CONNECTIONS. CONTRACTOR SHALL PROVIDE AND SUBMIT DRAWINGS AND STRUCTURAL CALCULATIONS, BOTH SEALED BY A PROFESSIONAL ENGINEER CURRENTLY REGISTERED IN THE STATE OR COMMONWEALTH WHERE THE PROJECT IS LOCATED.

ALUMINUM GUARDS AND HANDRAILS
S-05-0601



TYPE I DOUBLE ANGLE

NOMINAL BEAM DEPTH	(n) ROWS	L
8"-10"	2	5 1/2"
12"-15"	3	8 1/2"
16"-18"	4	11 1/2"
21"	5	1'-2 1/2"
24"	6	1'-5 1/2"
27"	7	1'-8 1/2"
30"	8	1'-11 1/2"
33"	9	2'-2 1/2"
36"	10	2'-5 1/2"



TYPE II SINGLE PLATE

W SHAPE LOWER BOUND CAPACITY (KIPS) SEE NOTES TO ENGINEER			
DOUBLE ANGLE		SINGLE PLATE	
ASD	LRFD	ASD	LRFD
12.4	18.7	12.4	18.7
23.0	34.4	23.0	34.4
39.0	58.5	39.0	58.5
69.0	103.6	54.1	81.3
94.4	141.4	59.3	89.1
128.8	193.2	72.1	108.0
151.3	227.0	84.7	127.0
185.0	278.0	94.8	142.0
205.0	308.0	105.0	157.0

NOTE : CHART NOT
APPLICABLE TO CHANNELS

NOTE:
TYPE I DOUBLE ANGLE CONNECTION
SHALL BE USED UNO ON DRAWINGS.

STEEL FRAMING CONNECTION
S-05-0102

REV	ISSUED FOR	DATE	BY

PROJECT ENGINEER:	J. BOWDEN
DESIGNED BY:	J. SILVA
DRAWN BY:	E. McCLELLAN
CHECKED BY:	J. SILVA

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE 0 1/2" 1"

Hazen
HAZEN AND SAWYER
4000 HOLLYWOOD BLVD SUITE 750N
HOLLYWOOD, FL 33021

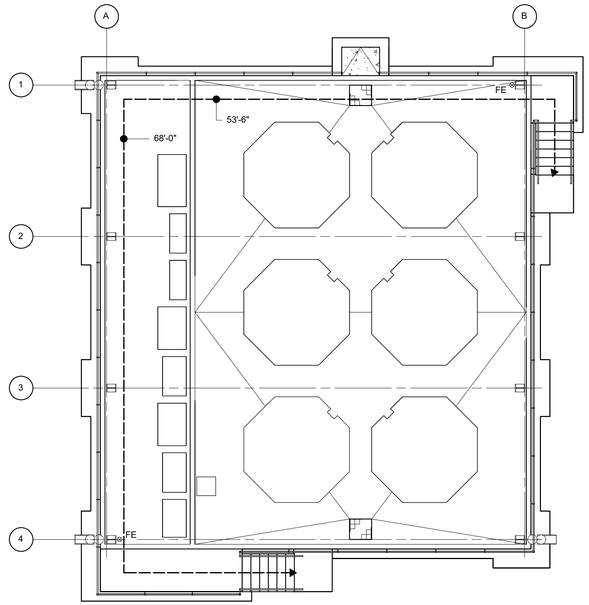
CITY OF HOLLYWOOD
HOLLYWOOD, FLORIDA

SODIUM HYPOCHLORITE
TEMPORARY STORAGE AND FEED SYSTEM

STRUCTURAL
TYPICAL DETAILS
SHEET 2

DATE:	DECEMBER 2025
PROJECT NO.:	4321-111
CONTRACT NO.:	22-8073
DRAWING NUMBER:	S-12

Autodesk Docs://04321-111/04321-111-General-Stru.rvt
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LIFE SAFETY PLAN

1/8" = 1'-0"

FLOOD HAZARD DOCUMENTATION

PARAMETER	VALUE			NOTES
SITE ADDRESS	1621 NORTH 14TH AVE, HOLLYWOOD, FL 33020			
FEMA FIRM PANEL 2014	12011C0569H			
FEMA EFFECTIVE JULY 31, 2024	12011C0569J			
FEMA BASE (100-YEAR) FLOOD ELEVATION	6.00			
FLOOD ZONE	MIX OF ZONE X AND ZONE AE			
IS PROJECT SITE HIGHER THAN THE 100-YEAR FLOOD ELEVATION?	NO			
IS PROJECT SITE HIGHER THAN THE 500-YEAR FLOOD ELEVATION?	NO			
	2014 FIRM MAP	BROWARD COUNTY PLATE WM 13.1 FUTURE CONDITIONS		
BASE FLOOD ELEVATION, BFE (NAVD 1988) FOR THE PROJECT SITE	5.00	6.50	FEMA EFFECTIVE JULY 31, 2024 6.00	
NEAREST 100-YR FLOOD ELEVATION TO THE PROJECT SITE ON FIRM MAP (NAVD1988)	5.00	6.50	6.00	
FLOOD DESIGN CLASS	3	3	6.00	
TEMPORARY SODIUM HYPOCHLORITE AREA			3	
FLOOR EL (NAVD1988)*	8.50	8.50		ASCE 24-14 TABLE 2-1
MINIMUM FINISHED FLOOR EL			8.50	
CRITERION	BFE+2	BFE+2		
REQUIRED VALUE (NAVD1988)	7.00	8.50		
DESIGN VALUE (NAVD1988)	8.50	8.50		
COMPLIES	YES	NO	BFE+2 8.00 8.50 YES	
MINIMUM EQUIPMENT EL				ASCE 24-14 TABLE 2-1
CRITERION	BFE+2	BFE+2		
REQUIRED VALUE (NAVD1988)	7.00	8.50		
DESIGN VALE (NAVD1988)	9.00	9.00		
COMPLIES	YES	YES	BFE+2 8.00 YES	
ASCE 24-14: AMERICAN SOCIETY OF CIVIL ENGINEERS STANDARD TITLED "FLOOD RESISTANT DESIGN AND CONSTRUCTION".				
NAVD: NORTH AMERICAN VERTICAL DATUM				ASCE 24-14 TABLE 7-1
NGVD: NATIONAL GEODETIC VERTICAL DATUM				

BFE: BASE FLOOD ELEVATION

BUILDING CODE ANALYSIS
2023 FLORIDA BUILDING CODE, 8TH EDITION

FLORIDA BUILDING CODE - (FBC) 2023, 8TH EDITION: WITH LATEST CHANGES TO 2021 IBC WITH STATEWIDE AMENDMENTS
FLORIDA FIRE PREVENTION CODE (FFPC) 2023, 8TH EDITION: NFPA 1 FIRE CODE (FC) 2021 WITH AMENDMENTS
NFPA 101 LIFE SAFETY CODE (LSC) 2021 WITH AMENDMENTS

SUMMARY OF WORK

NEW BUILDING CONSTRUCTION (FBC) FBC SC1609 << ADD WIND LOAD REQUIREMENTS>>

SCOPE OF WORK: NEW BUILDING CONSTRUCTION CONTAINING A TEMPORARY SODIUM HYPOCHLORITE STORAGE AREA.

	FLORIDA BUILDING CODE - (FBC) 2023, 8TH EDITION BASED ON 2021 IBC WITH AMENDMENTS			FLORIDA FIRE PREVENTION CODE (FFPC) 2023 NFPA 1 FIRE CODE (FC) 2021 WITH AMENDMENTS NFPA 101 LIFE SAFETY CODE (LSC) 2021 WITH AMENDMENTS		
CODE ITEM	REFERENCE	ALLOWED	PROVIDED	REFERENCE	ALLOWED	PROVIDED
OCCUPANCY AND CONSTRUCTION CLASSIFICATION						
OCCUPANCY HAZARD CLASSIFICATION	FBC CHAPTER 3	FBC 602.2	F-1	LSC CHAPTER 40	LSC 40.1.2.1.2	SPECIAL-PURPOSE INDUSTRIAL
SODIUM HYPOCHLORITE STORAGE AREA		FBC 602.2			LSC 8.2.1.2, NFPA 220	
CONSTRUCTION CLASSIFICATION	TABLE 601		TYPE II-B	LSC CHAPTER 8		TYPE II (000)
BUILDING REQUIREMENTS						
BUILDING HEIGHT (FEET)	TABLE 504.3A	55 FT	22 FT	NO COMPARABLE REQUIREMENT		
SODIUM HYPOCHLORITE STORAGE AREA		3	SINGLE STORY			
BUILDING HEIGHT (STORIES)	TABLE 504.4					
BUILDING AREA		(NS) 15,500 SF	(NS) 2,274 SF			
SODIUM HYPOCHLORITE STORAGE AREA	TABLE 506.2					
STRUCTURAL FRAME	FIRE RESISTANCE RATING REQUIREMENTS	0 HR	0 HR		0 HR	0 HR
EXTERIOR NON-BEARING WALLS	FBC TABLES 601 & 602	0 HR	0 HR	LSC 8.2.1.2 NFPA 220 TABLE 4.1.1	0 HR	0 HR
INTERIOR NON-BEARING WALLS		0 HR	0 HR		0 HR	N/A
FLOOR CONSTRUCTION		0 HR	0 HR		0 HR	N/A
ROOF CONSTRUCTION		NONE	N/A	FC TABLE 12.7.6.2.2	NONE	N/A
SHAFT ENCLOSURES	713	NONE	N/A	FC 12.4.2 NFPA 80 CH 4	NONE	N/A
OPENING PROTECTIVES	716.3					
INTERIOR FINISH	803.11	CLASS A	CLASS A	LSC 10.2.3	CLASS C	CLASS C
NOTES:						
EGRESS REQUIREMENTS	(a)	(b)	(c=a/b)	(p)	(q)	(r=p/q)
USE GROUP OR SPACE DESCRIPTION (FBC & LSC)	AREA (SF)	LOAD FACTOR TABLE 1004.5	OCCUPANT LOAD	AREA (SF)	LOAD FACTOR TABLE 7.3.1.2	OCCUPANT LOAD
SODIUM HYPOCHLORITE STORAGE AREA	2274 SF	100 GROSS	CALCULATED OCCUPANT LOAD 8 PEOPLE	2274 SF	300 GROSS	8 PEOPLE
MINIMUM CORRIDOR WIDTH	1020.3	24"	N/A	LSC 7.3.4.1	36"	N/A
SODIUM HYPOCHLORITE STORAGE AREA	1020.2	0	N/A	LSC 40.3.6	NONE	N/A
CORRIDOR FIRE RESISTANCE RATING	MINIMUM EGRESS WIDTH AND TRAVEL DISTANCE					
MINIMUM WIDTH OF EGRESS COMPONENT	CHAPTER 10	OCCUPANT LOAD x 0.2	8x0.2" = 4"	LSC 7.3.4	36"	36"
SODIUM HYPOCHLORITE STORAGE AREA	10.5.3.2					
EXIT ACCESS TRAVEL DISTANCE	TABLE 1017.2	200 (NS)	68 (NS)	LSC TABLE 40.2.6.1	300' (NS)	68' (NS)
SODIUM HYPOCHLORITE STORAGE AREA						
COMMON PATH OF TRAVEL DISTANCE	TABLE 1006.2.1	75 (NS)	N/A	LSC TABLE 40.2.5.1	50' (NS)	N/A
SODIUM HYPOCHLORITE STORAGE AREA						
DEAD END CORRIDOR DISTANCE	1020.5	20 (NS)	N/A	LSC TABLE 40.2.5.1	50' (NS)	N/A
SODIUM HYPOCHLORITE STORAGE AREA						
(NS) NON-SPRINKLERED						

SODIUM HYPOCHLORITE INFORMATION

PARAMETER	VALUE
CHEMICAL NAME	12.5% Sodium Hypochlorite Nominal
FORMULA	NaOCL
CAS #	7681-52-9
STATE (at normal temperture and pressure)	LIQUID
NFPA 704 RATING	
• HEALTH • FLAMMABILITY • REACTIVITY • SPECIAL	2 0 1 NONE
STORAGE LOCATION	DUAL WALLED POLYETHYLENE STORAGE TANK
TANK DIAMETER	12'-4"
TANK HIEGHT	15'-8"
NUMBER OF TANKS	6
SECONDARY CONTAINMENT VOLUME	DUAL CONTAINMENT TYPE WITH THE CONTAINMENT VOLUME MEETING OR EXCEEDING 110% OF THE INNER USABLE TANK CAPACITY (6650 GAL)
HAZARDOUS MATERIAL CLASSIFICATION (60.3.1, FLORIDA FIRE PREVENTION CODE, NFPA 1, 6TH EDITION)	IRRITANT
CLASSIFICATION OF HIGH HAZARD CONTENTS (60.3.2.1.2.4, FLORIDA FIRE CODE, NFPA 1, 6TH EDITION)	NOT APPLICABLE
OCCUPANCY (6.1.13, FLORIDA FIRE PREVENTION CODE, NFPA 101, 6TH EDITION)	STORAGE
HAZARD OF CONTENTS (42.1.5.2, FLORIDA FIRE PREVENTION CODE, NFPA 101, 6TH EDITION)	NOT APPLICABLE
HAZARD OF CONTENTS (42.1.5.2, FLORIDA FIRE PREVENTION CODE, NFPA 101, 6TH EDITION)	NOT APPLICABLE

LIFE SAFETY SYSTEMS

	FLORIDA BUILDING CODE - (FBC) 2023, 8TH EDITION BASED ON 2021 IBC WITH AMENDMENTS			FLORIDA BUILDING CODE - (FBC) 2023, 8TH EDITION BASED ON 2021 IBC WITH AMENDMENTS		
CODE ITEM	REFERENCE	REQUIRED	PROVIDED	REFERENCE	REQUIRED	PROVIDED
EMERGENCY LIGHTING	1008	REQUIRED	YES	LSC 7.8, 7.9	YES	YES
EXIT SIGNS	1013	REQUIRED	YES	LSC 7.10.1.5	YES	YES
AUTOMATIC SPRINKLERS						
SODIUM HYPOCHLORITE STORAGE AREA	903.2.4	NOT REQUIRED	NO	LSC 40.3	NOT REQUIRED	N/A
FIRE ALARM	907	NOT REQUIRED	NONE	LSC 40.3.4.1	NOT REQUIRED	NONE
SMOKE DETECTION	907	NOT REQUIRED	NONE	LSC 40.3.4.1	NOT REQUIRED	NONE
PANIC HARDWARE	1010.1.10	N/A	NONE	LSC 7.2.1.7	NOT REQUIRED	YES
FIRE EXTINGUISHERS	906	NFPA 10	YES	FC TABLE 13.6.1.2	REQUIRED	YES
HAZARD CLASSIFICATION	NFPA 10: 5.4.1.1	LIGHT HAZARD	LIGHT HAZARD	NFPA 10: 5.4.1.1	LIGHT HAZARD	EXTRA HIGH HAZARD
OCCUPANCY HAZARD CLASSIFICATION	NFPA: 5.2	CLASS A BC	CLASS A BC	NFPA: 5.2	CLASS A BC	CLASS A BC
FIRE EXTINGUISHER - DRY CHEMICAL		10LB 2A: 40BC	10LB 2A: 40BC		10LB 2A: 40BC	10LB 2A: 40BC
TRAVEL DISTANCE	906.3 (1)	75 FT MAX	47 FT MAX	NFPA 10 TABLE 6.2.1.1	75 FT MAX	47 FT MAX
FLOOR AREA PER EXTINGUISHER		11,250 SF/UNIT	1137 SF		11,250 SF/UNIT	1137 SF
LIFE SAFETY NOTES	SODIUM HYPOCHLORITE STORAGE AREA IS ACCESSED ONLY BY PERSONNEL FOR MAINTENANCE, MONITORING, OR REPAIR.					
STRUCTURAL LOADS	STRUCTURAL AND WIND LOADS, SEE STRUCTURAL DRAWINGS.					
PLUMBING FIXTURES	PLUMBING FIXTURES - SEE PLUMBING DWGS.					
ACCESSIBILITY	REQUIRED EXCEPT FOR PROCESS AREA, MECHANICAL AND ELECTRICAL ROOMS.					

EGRESS WIDTH PER OCCUPANT

CAPACITY FACTOR		CALCULATED		ALLOWED		PROVIDED		CAPACITY FACTOR		CALCULATED		ALLOWED		PROVIDED	
(d) STAIR 1005.3.1	(e) DOOR 1005.3.2	(c*d) STAIR CALC	(c*e) DOOR CALC	STAIR 1011.2	DOOR 1010.1.1	STAIR CLEAR WIDTH	DOOR CLEAR WIDTH	(s) STAIR 7.3.3.1	(t) DOOR 7.3.3.1	(r*s) STAIR CALC	(r*t) DOOR CALC	STAIR 40.2.5.3.1	DOOR 7.2.1.2.3.2	STAIR CLEAR WIDTH	DOOR CLEAR WIDTH
0.3	0.2	8x0.3"	N/A	2.4"	N/A	48"	N/A	0.3	0.2	2.4"	N/A	36"	N/A	48"	N/A

REV	ISSUED FOR	DATE	BY

PROJECT ENGINEER:	J. BOWDEN
DESIGNED BY:	J. SILVA
DRAWN BY:	E. McCLELLAN
CHECKED BY:	J. SILVA

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE 0 1/2" 1"

Hazen
HAZEN AND SAWYER
4000 HOLLYWOOD BLVD SUITE 750N
HOLLYWOOD, FL 33021

CITY OF HOLLYWOOD
HOLLYWOOD, FLORIDA

SODIUM HYPOCHLORITE
TEMPORARY STORAGE AND FEED SYSTEM

ARCHITECTURAL
TEMPORARY HYPOCHLORITE SYSTEM
LIFE SAFETY PLAN

DATE: DECEMBER 2025
PROJECT NO.: 4321-111
CONTRACT NO.: 22-8073
DRAWING NUMBER: A-01

Autodesk Docs://04321-111/04321-111-100-S.rvt
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INSTRUMENT AND FUNCTION SYMBOLS

LOCATION AND ACCESSIBILITY	SHARED DISPLAY/SHARED CONTROL		COMPUTER SYSTEMS AND SOFTWARE	DISCRETE
	PRIMARY CHOICE OR BASIC PROCESS CONTROL SYSTEM	ALTERNATE CHOICE OR SAFETY INSTRUMENTED SYSTEM		
LOCATED IN FIELD NOT PANEL, CABINET, OR CONSOLE MOUNTED VISIBLE AT FIELD LOCATION NORMALLY OPERATOR ACCESSIBLE	ABCD 12345	ABCD 12345	ABCD 12345	ABCD 12345
LOCATED IN OR ON FRONT OF CENTRAL OR MAIN PANEL OR CONSOLE VISIBLE ON FRONT OF PANEL OR ON VIDEO DISPLAY NORMALLY OPERATOR ACCESSIBLE AT PANEL FRONT OR CONSOLE	ABCD 12345	ABCD 12345	ABCD 12345	ABCD 12345
LOCATED IN REAR OF CENTRAL OR MAIN PANEL LOCATED IN CABINET BEHIND PANEL NOT VISIBLE ON FRONT OF PANEL OR ON VIDEO DISPLAY NOT NORMALLY OPERATOR ACCESSIBLE AT PANEL OR CONSOLE	ABCD 12345	ABCD 12345	ABCD 12345	ABCD 12345
LOCATED IN OR ON FRONT OF SECONDARY OR LOCAL PANEL OR CONSOLE VISIBLE ON FRONT OF PANEL OR ON VIDEO DISPLAY NORMALLY OPERATOR ACCESSIBLE AT PANEL FRONT OR CONSOLE	ABCD 12345	ABCD 12345	ABCD 12345	ABCD 12345
LOCATED IN REAR OF SECONDARY OR LOCAL PANEL LOCATED IN FIELD CABINET NOT NORMALLY OPERATOR ACCESSIBLE AT PANEL OR CONSOLE	ABCD 12345	ABCD 12345	ABCD 12345	ABCD 12345

X — SUFFIX (X) TO DIFFERENTIATE BETWEEN INSTRUMENTS AND FUNCTIONS THAT WOULD OTHERWISE HAVE THE SAME IDENTIFICATION.

SINGLE INSTRUMENT OR OTHER COMPONENT HAVING MULTIPLE FUNCTIONS OR SHARING A COMMON HOUSING

(ZZZ) — DESIGNATIONS OF CONTROL FUNCTIONS (ZZZ) ASSOCIATED WITH INSTRUMENT OR OTHER COMPONENTS.

AHC	-	AUTO/HOLD/CLOSE	OC	-	OPEN/CLOSE
AM	-	AUTO/MANUAL	OSC	-	OPEN/STOP/CLOSED
CALC	-	CALCULATION	POT	-	POTENTIOMETER
DEV	-	DEVIATION	RL	-	RAISE/LOWER
MOA	-	MANUAL/OFF/AUTO	RS	-	RUN/STOP
HOR	-	HAND/OFF/REMOTE	RSL	-	RAISE/STOP/LOWER
LOS	-	LOCKOUT STOP	SD	-	SHUTDOWN
LR	-	LOCAL/REMOTE	SEL	-	SELECT
LSR	-	LOCAL/STOP/REMOTE	SP	-	SET POINT
00	-	ON / OFF	SR	-	START/RESET
			SS	-	STOP/START

* — INSTRUMENT WITH COMPUTING OR CONVERTING FUNCTION

* — CONTROL SYSTEM COMPUTING FUNCTION

CONVERT

E - VOLTAGE
I - CURRENT
P - PNEUMATIC
A - ANALOG
B - BINARY
H - HYDRAULIC
O - ELECTROMAGNETIC, SONIC
R - RESISTANCE (ELECT.)
D - DIGITAL

COMPUTE

Σ	SUMMING	P	PROPORTIONAL	△	DIFFERENCE
—	SUBTRACTOR	R	DERIVATIVE	>	HIGH SELECTING
X	MULTIPLYING	Σ/n	AVERAGING	<	LOW SELECTING
÷	DIVIDING	I:I	RATIO	∫	INTEGRAL
n√	ROOT EXTRACTION	PID	PID	#	COMPLEX FUNCTION

= 1, 2, 3, etc.
REFER TO NOTE ON SAME SHEET FOR BRIEF DESCRIPTION

* — ELECTRICAL CONTROL INTERLOCK

\# — COMPLEX INTERLOCK
= 1, 2, 3, etc.
REFER TO NOTE ON SAME SHEET FOR BRIEF DESCRIPTION

AND — AND LOGIC

OR — OR LOGIC

ABCD 1234 — PILOT LIGHT

VALVE, GATE, AND ACTUATOR SYMBOLS

- GATE VALVE
- PLUG VALVE
- GLOBE VALVE
- BALL VALVE
- BUTTERFLY VALVE
- BALL CHECK VALVE
- SWING CHECK VALVE
- CHECK VALVE
- 3-WAY VALVE
- 3-WAY BALL VALVE
- DIAPHRAGM VALVE
- PINCH VALVE
- NEEDLE VALVE
- SLUICE GATE
- STOP/SLIDE GATE
- S — SOLENOID ACTUATOR
- P — PNEUMATIC ACTUATOR
- BACKFLOW PREVENTER
- PRESSURE RELIEF VALVE
- VACUUM RELIEF VALVE
- COMBINATION VACUUM AND PRESSURE RELIEF VALVE
- PRESSURE-REDUCING REGULATOR
- BACKPRESSURE REGULATOR
- V — AIR RELEASE VALVE
- M — ROTARY MOTOR
- E/H — ELECTROHYDRAULIC ACTUATOR
- MANUAL ACTUATOR

PUMP AND EQUIPMENT SYMBOLS

- CENTRIFUGAL WET PIT PUMP (OR DRY-PIT SUBMERSIBLE)
- BLOWER (CENTRIFUGAL)
- GEAR PUMP OR BLOWER (POSITIVE DISPLACEMENT)
- CHOPPER PUMP
- PISTON PUMP
- DIAPHRAGM PUMP
- ROTARY LOBE PUMP OR BLOWER (POSITIVE DISPLACEMENT)
- METERING PUMP
- COMPRESSOR
- PROGRESSIVE CAVITY PUMP
- VERTICAL PUMP
- INLINE GRINDER
- CENTRIFUGAL PUMP
- SCREW CENTRIFUGAL PUMP
- M — MIXER

MISCELLANEOUS SYMBOLS

- EXPANSION JOINT
- QUICK CONNECT
- BLIND FLANGE
- FLEXIBLE HOSE
- CALIBRATION CYLINDER
- PULSATION DAMPENER
- EXPANSION TANK
- HORN
- HORN/STROBE
- RUPTURE DISK
- V — VENT
- DIAPHRAGM SEAL
- FULL LINE OR TAPPED RING SEAL
- D — DRAIN
- XXXX-YYYY — EQUIPMENT OR PANEL TAG
- M — MOTOR
- FILTER
- AIR FILTER
- STATIC MIXER
- INJECTOR

IDENTIFICATION LETTERS

	FIRST LETTERS: MEASURED OR INITIATING VARIABLE	FIRST LETTERS: VARIABLE MODIFIER	SUCCEEDING LETTERS: READOUT/ PASSIVE FUNCTION	SUCCEEDING LETTERS: OUTPUT/ ACTIVE FUNCTION	SUCCEEDING LETTERS: FUNCTION MODIFIER
A	ANALYSIS		ALARM		
B	BURNER, COMBUSTION		USER'S CHOICE	USER'S CHOICE	USER'S CHOICE
C	CONDUCTIVITY			CONTROL	CLOSE
D	DENSITY (MASS) OR SPECIFIC	DIFFERENCE, DIFFERENTIAL			DEVIATION
E	GRAVITY VOLTAGE (EMF)		SENSOR, PRIMARY ELEMENT		
F	FLOW, FLOW RATE	RATIO			
G	USER'S CHOICE		GLASS, GAUGE, VIEWING DEVICE		
H	HAND				HIGH
I	CURRENT		INDICATE		
J	POWER		SCAN		
K	TIME, SCHEDULE	TIME RATE OF CHANGE		CONTROL STATION	
L	LEVEL		LIGHT		LOW
M	MOISTURE OR HUMIDITY	MOMENTARY			MIDDLE, INTERMEDIATE
N	TORQUE		USER'S CHOICE	USER'S CHOICE	USER'S CHOICE
O	USER'S CHOICE		ORIFICE, RESTRICTION		OPEN
P	PRESSURE		POINT (TEST CONNECTION)		
Q	QUANTITY	INTEGRATE, TOTALIZE	INTEGRATE, TOTALIZE		
R	RADIATION		RECORD		RUN
S	SPEED, FREQUENCY	SAFETY		SWITCH	STOP
T	TEMPERATURE			TRANSMIT	
U	MULTIVARIABLE		MULTIFUNCTION	MULTIFUNCTION	
V	VIBRATION, MECHANICAL ANALYSIS			VALVE, DAMPER, LOUVER	
W	WEIGHT, FORCE		WELL PROBE		
X	UNCLASSIFIED	X-AXIS	ACCESSORY DEVICES, UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED
Y	EVENT, STATE, PRESENCE	Y-AXIS		AUXILIARY DEVICES	
Z	POSITION, DIMENSION	Z-AXIS, SAFETY INSTRUMENTED SYSTEM		DRIVER, ACTUATOR, UNCLASSIFIED FINAL CONTROL ELEMENT	

PRIMARY ELEMENT SYMBOLS

- M — MAGNETIC FLOW METER
- SONIC FLOW METER
- ΔT — THERMAL MASS FLOW METER
- TURBINE OR PADDLE WHEEL TYPE FLOW METER
- VENTURI FLOW METER
- AVERAGING PITOT TUBE
- FICV — ROTAMETER WITH INTEGRAL VALVE
- ABCD 1234 XX — XX: RF=ADMITTANCE/CAPACITANCE MAN=MANOMETER
- ULTRASONIC LEVEL SENSOR
- SUBMERSIBLE LEVEL SENSOR
- NON-CONTACT RADAR LEVEL SENSOR
- GUIDED WAVE RADAR LEVEL SENSOR
- FLOAT LEVEL SWITCH
- CAPACITANCE LEVEL SENSOR
- SLIDING FLOAT TYPE LEVEL SWITCH

ANALYTICAL ABBREVIATIONS

AXX 12345 — ANALYSIS INSTRUMENT

(ZZZ) (ZZZ) = ALK - ALKALINITY

CH4	-	METHANE
CL2	-	CHLORINE
COMB	-	COMBUSTIBLE GAS
CON	-	CONDUCTIVITY
DO	-	DISSOLVED OXYGEN
IR	-	INFRARED
H2S	-	HYDROGEN SULFIDE
LEL	-	LOWER EXPLOSIVE LIMIT
METH	-	METHANOL VAPOR
NH3	-	AMMONIA
NO3	-	NITRATE
O2	-	OXYGEN
O3	-	OZONE
ORP	-	OXIDATION/REDUCTION POTENTIAL
PETRO	-	PETROLEUM VAPOR
PH	-	HYDROGEN ION CONCENTRATION
PO4	-	PHOSPHATE
SO2	-	SULFUR DIOXIDE
TH	-	TOTAL HARDNESS
TSS	-	TOTAL SUSPENDED SOLIDS
TURB	-	TURBIDITY
UV	-	ULTRAVIOLET

GENERAL NOTES

1. SYMBOLS AND NOMENCLATURE ARE BASED ON ANSI/ISA-5.1-2009.
2. REFER TO LEGEND SHEETS OF OTHER DISCIPLINES FOR ADDITIONAL SYMBOLS AND ABBREVIATIONS.
3. REFER TO SPECIFICATIONS FOR ADDITIONAL DETAIL ON CONTROL SYSTEM FUNCTIONAL REQUIREMENTS.
4. INSTRUMENTS AND PANELS DENOTED WITH AN ASTERISK (*) ARE PROVIDED BY OTHER DISCIPLINES UNDER THIS CONTRACT. REFER TO THE DRAWINGS AND SPECIFICATIONS FOR ADDITIONAL DETAIL.
5. POWER SUPPLIES FOR LOOPS OR SYSTEMS SHALL BE FURNISHED BY THE INSTRUMENTATION SUPPLIER TO MEET THE PARTICULAR CHARACTERISTICS (E.G., VOLTAGE AND CURRENT REQUIREMENTS) OF COMPONENTS IN EACH LOOP OR SYSTEM.

LINE SYMBOLS AND LEGEND

- MAJOR PROCESS PIPES OR CHANNELS
- SECONDARY PROCESS OR MECHANICAL CONNECTION
- AIR SUPPLY OR SIGNAL
- ELECTRICAL SIGNAL/ COPPER CABLE
- DATA LINK OR INTERNAL SOFTWARE LINK
- FO — FIBER OPTIC CABLE
- C6 — CAT6 CABLE

REFER TO SYSTEM ARCHITECTURE SHEETS FOR LINETYPES REPRESENTING OTHER MEDIA AND PROTOCOLS

- PROCESS/SIGNALS NOT CONNECTED (CROSSING)
- PROCESS/SIGNALS CONNECTED
- TAG / DRAWING — OFF-SHEET CONNECTOR
- DISCRETE ELECTRICAL SIGNALS
- DISCRETE DIGITAL SIGNALS
- ANALOG ELECTRICAL SIGNALS
- ANALOG DIGITAL SIGNALS

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DESIGNED BY:	AJM
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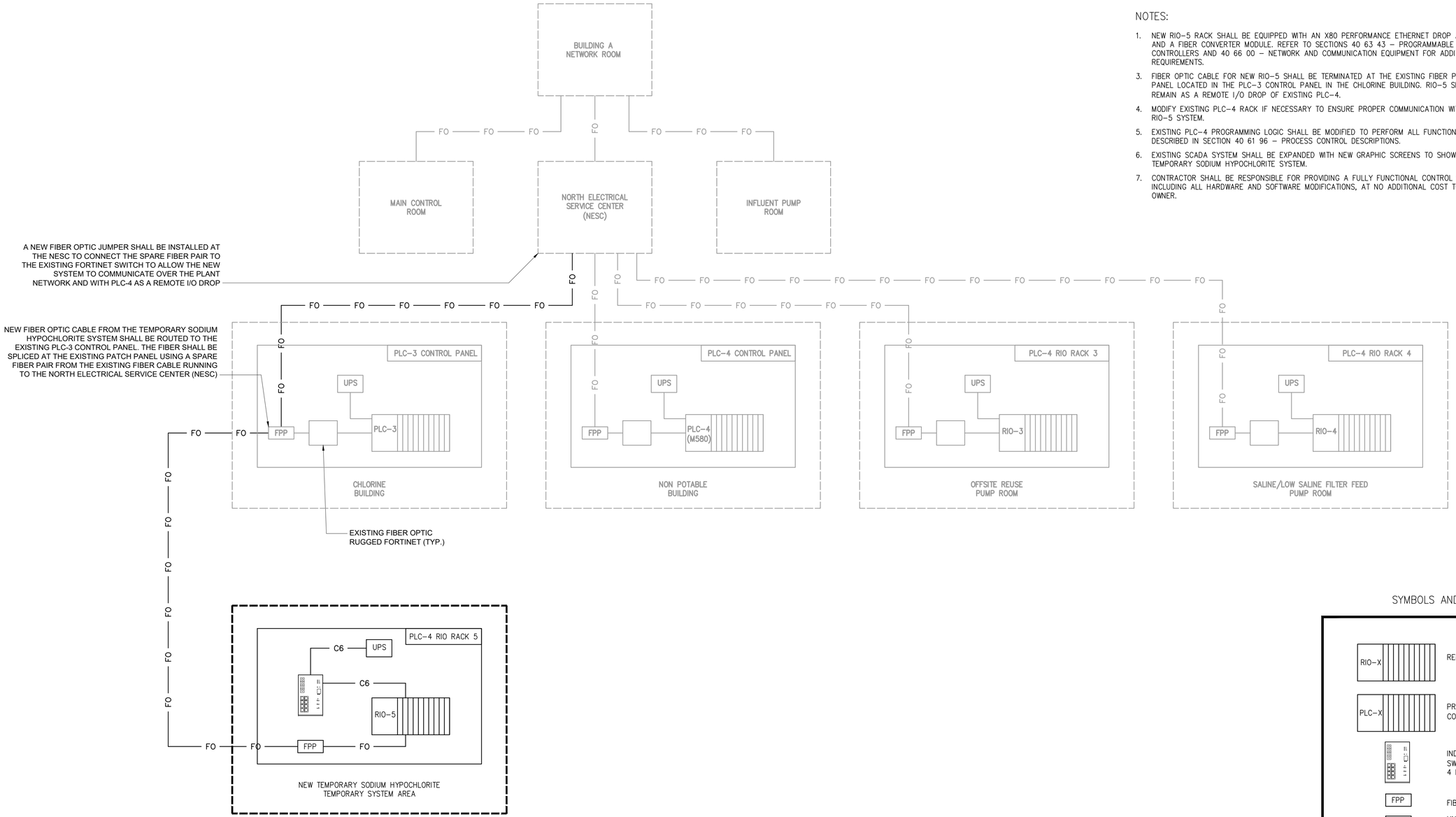
CITY OF HOLLYWOOD
HOLLYWOOD, FLORIDA

SODIUM HYPOCHLORITE
TEMPORARY STORAGE AND FEED SYSTEM

INSTRUMENTATION
SYMBOLS AND LEGEND

DATE:	DECEMBER 2025
HAZEN NO.:	4321-111
CONTRACT NO.:	22-8073
DRAWING NUMBER:	I-01

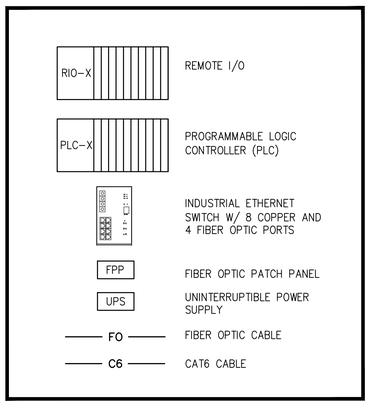
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NOTES:

1. NEW RIO-5 RACK SHALL BE EQUIPPED WITH AN X80 PERFORMANCE ETHERNET DROP ADAPTER AND A FIBER CONVERTER MODULE. REFER TO SECTIONS 40 63 43 – PROGRAMMABLE LOGIC CONTROLLERS AND 40 66 00 – NETWORK AND COMMUNICATION EQUIPMENT FOR ADDITIONAL REQUIREMENTS.
3. FIBER OPTIC CABLE FOR NEW RIO-5 SHALL BE TERMINATED AT THE EXISTING FIBER PATCH PANEL LOCATED IN THE PLC-3 CONTROL PANEL IN THE CHLORINE BUILDING. RIO-5 SHALL REMAIN AS A REMOTE I/O DROP OF EXISTING PLC-4.
4. MODIFY EXISTING PLC-4 RACK IF NECESSARY TO ENSURE PROPER COMMUNICATION WITH NEW RIO-5 SYSTEM.
5. EXISTING PLC-4 PROGRAMMING LOGIC SHALL BE MODIFIED TO PERFORM ALL FUNCTIONS DESCRIBED IN SECTION 40 61 96 – PROCESS CONTROL DESCRIPTIONS.
6. EXISTING SCADA SYSTEM SHALL BE EXPANDED WITH NEW GRAPHIC SCREENS TO SHOW THE NEW TEMPORARY SODIUM HYPOCHLORITE SYSTEM.
7. CONTRACTOR SHALL BE RESPONSIBLE FOR PROVIDING A FULLY FUNCTIONAL CONTROL SYSTEM, INCLUDING ALL HARDWARE AND SOFTWARE MODIFICATIONS, AT NO ADDITIONAL COST TO THE OWNER.

SYMBOLS AND LEGEND



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SODIUM HYPOCHLORITE
TEMPORARY STORAGE AND FEED SYSTEM

INSTRUMENTATION NETWORK BLOCK DIAGRAM

DATE:	DECEMBER 2025
HAZEN NO.:	4321-111
CONTRACT NO.:	22-8073
DRAWING NUMBER:	I-02

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NaCLO. BULK STORAGE TANK No. 2 (TK-65412) NaCLO. BULK STORAGE TANK No. 4 (TK-65414) NaCLO. BULK STORAGE TANK No. 6 (TK-65416)

NaCLO. BULK STORAGE TANK No. 1 (TK-65411) NaCLO. BULK STORAGE TANK No. 3 (TK-65413) NaCLO. BULK STORAGE TANK No. 5 (TK-65415)

HMI (SCADA)

LEVEL ALARM HIGH HIGH LAHH 65410 A
LEVEL ALARM HIGH HIGH LAHH 65410 B
VOLUME LQI 65412
LOW LEVEL ALARM LAL 65412
LEVEL LI 65412
MAX FILL LVL ALM LAH 65412
HH LVL ALM LAHH 65412
VOLUME LQI 65414
LOW LEVEL ALARM LAL 65414
LEVEL LI 65414
MAX FILL LVL ALM LAH 65414
HH LVL ALM LAHH 65414
VOLUME LQI 65416
LOW LEVEL ALARM LAL 65416
LEVEL LI 65416
MAX FILL LVL ALM LAH 65416
HH LVL ALM LAHH 65416
VOLUME LQI 65411
LOW LEVEL ALARM LAL 65411
LEVEL LI 65411
MAX FILL LVL ALM LAH 65411
HH LVL ALM LAHH 65411
VOLUME LQI 65413
LOW LEVEL ALARM LAL 65413
LEVEL LI 65413
MAX FILL LVL ALM LAH 65413
HH LVL ALM LAHH 65413
VOLUME LQI 65415
LOW LEVEL ALARM LAL 65415
LEVEL LI 65415
MAX FILL LVL ALM LAH 65415
HH LVL ALM LAHH 65415

1 UIC 65412
1 UIC 65414
1 UIC 65416
1 UIC 65411
1 UIC 65413
1 UIC 65415

RIO-5 (PLC-4)

FUNCTIONAL CONTROL DESCRIPTION NOTES:

1 PROVIDE VOLUMETRIC CALCULATION AND DIGITAL ALARMS BASED ON LEVEL TRANSMITTER MEASUREMENTS. THE SETPOINT FOR THE HIGH-HIGH LEVEL ALARM SHALL BE CONFIGURED ABOVE THE MAXIMUM FILL LEVEL SETPOINT.

NOTES:

1. ALL BALL VALVES FOR SODIUM HYPOCHLORITE SERVICE SHALL BE VENTED TYPE CPVC BALL VALVES. REFER TO VALVE SCHEDULE IN MECHANICAL SPECIFICATIONS FOR MORE INFORMATION.
2. SEE NON-CONTACT RADAR INSTALLATION DETAIL ON I-10.

ES 120/1

WEST SODIUM HYPOCHLORITE UNLOADING LOCAL ALARM PANEL — LAP–65422
BULK STORAGE TANK No. 2: LEVEL LI 65412; MAX FILL LEVEL LAH 65412; HH LVL ALARM LAHH 65412
BULK STORAGE TANK No. 4: LEVEL LI 65414; MAX FILL LEVEL LAH 65414; HH LVL ALARM LAHH 65414
BULK STORAGE TANK No. 6: LEVEL LI 65416; MAX FILL LEVEL LAH 65416; HH LVL ALARM LAHH 65416
RESET/ HORN SILENCE HMS 65422

EAST SODIUM HYPOCHLORITE UNLOADING LOCAL ALARM PANEL — LAP–65421
BULK STORAGE TANK No. 1: LEVEL LI 65411; MAX FILL LEVEL LAH 65411; HH LVL ALARM LAHH 65411
BULK STORAGE TANK No. 3: LEVEL LI 65413; MAX FILL LEVEL LAH 65413; HH LVL ALARM LAHH 65413
BULK STORAGE TANK No. 5: LEVEL LI 65415; MAX FILL LEVEL LAH 65415; HH LVL ALARM LAHH 65415
RESET/ HORN SILENCE HMS 65421

TYP. UNLOADING ALARM PANEL. CONSTRUCTION PER DETAIL ON I-10

2" QUICK CONNECT WITH KEY LOCK DUST CAP (TYP.)

NOTE 2 (TYP.)

LT 65411 — SODIUM HYPOCHLORITE BULK STORAGE TANK No. 1 6650 GAL — TK-65411 — LG 65411
LT 65413 — SODIUM HYPOCHLORITE BULK STORAGE TANK No. 3 6650 GAL — TK-65413 — LG 65413
LT 65415 — SODIUM HYPOCHLORITE BULK STORAGE TANK No. 5 6650 GAL — TK-65415 — LG 65415
LT 65412 — SODIUM HYPOCHLORITE BULK STORAGE TANK No. 2 6650 GAL — TK-65412 — LG 65412
LT 65414 — SODIUM HYPOCHLORITE BULK STORAGE TANK No. 4 6650 GAL — TK-65414 — LG 65414
LT 65416 — SODIUM HYPOCHLORITE BULK STORAGE TANK No. 6 6650 GAL — TK-65416 — LG 65416

REVERSE FLOAT LEVEL GAUGE. (TYP.)

PAINTED STEEL PIPE SUPPORT DESIGNED BY CONTRACTOR. (TYP.)

FROM TP-56001

TO TP-56001

RESET/ HORN SILENCE HMS 65410
HIGH LEVEL ALARM LAH 65410 A
HIGH LEVEL ALARM LAH 65410 B
ES 120/1
SODIUM HYPOCHLORITE CONTAINMENT ALARM PANEL — CAP–65410

SLIDING TYPE LEVEL SWITCH (TYP.)

LSH 65410 A
LSH 65410 B

CONTAINMENT PUMP OUT

STORAGE TANK CONTAINMENT AREA

2" x 1" — TO RAS PUMP STATIONS — SH I-07
2" x 1" — TO CHLORINE CONTACT BASINS REUSE SYSTEM — SH I-04
2" x 1" — TO REUSE SYSTEM PRE-CHLORINATION — SH I-04
2" x 1" — TO CHLORINE CONTACT BASINS NON-POT SYSTEM — SH I-05
2" x 1" — TO NON-POT SYSTEM PRE-CHLORINATION — SH I-05
2" x 1" — TO HEADWORKS ODOR CONTROL SYSTEM — SH I-06
2" x 1" — TO OUTFALL PUMP STATION — SH I-06
2" x 1" — TO INFLUENT PUMP STATION — SH I-07

TO METERING PUMP SKIDS

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HOLLYWOOD, FLORIDA

SODIUM HYPOCHLORITE
TEMPORARY STORAGE AND FEED SYSTEM

INSTRUMENTATION
SODIUM HYPOCHLORITE
BULK STORAGE TANKS P&ID

DATE: DECEMBER 2025
HAZEN NO.: 4321-111
CONTRACT NO.: 22-8073
DRAWING NUMBER: I-03

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SODIUM HYPOCHLORITE METERING PUMP No. 1 (MP-56016)

FAIL TO START | FAIL TO STOP | READY | FAULT | IN REMOTE | RUN CMD | SPEED COMMAND | CALCULATED FLOW SPD

YAR 56016 | YAS 56016 | YX 56016 | YA 56016 | YL 56016 | YCR 56016 | SC 56016 | SI 56016

SODIUM HYPOCHLORITE METERING PUMP No. 2 (MP-56616)

FAULT | IN REMOTE | RUN CMD | SPEED COMMAND | CALCULATED FLOW SPD | FAIL TO START | FAIL TO STOP | READY

YA 56616 | YL 56616 | YCR 56616 | SC 56616 | SI 56616 | YAR 56616 | YAS 56616 | YX 56616

HMI (SCADA)

REUSE WATER FLOW — FE/FIT-54561 — PLC-4

INFLUENT CHLORINE RESIDUAL CONTROL — AE/AIT-54566 — PLC-4

2 FIC 56000

1 UIC 56000

RIO-5 (PLC-4)

SODIUM HYPOCHLORITE METERING PUMP No. 1 (MP-56013A)

FAIL TO START | FAIL TO STOP | READY | FAULT | IN REMOTE | RUN CMD | SPEED COMMAND | CALCULATED FLOW SPD

YAR 56013A | YAS 56013A | YX 56013A | YA 56013A | YL 56013A | YCR 56013A | SC 56013A | SI 56013A

SODIUM HYPOCHLORITE METERING PUMP No. 2 (MP-56613A)

FAULT | IN REMOTE | RUN CMD | SPEED COMMAND | CALCULATED FLOW SPD | FAIL TO START | FAIL TO STOP | READY

YA 56613A | YL 56613A | YCR 56613A | SC 56613A | SI 56613A | YAR 56613A | YAS 56613A | YX 56613A

HMI (SCADA)

FLOW FROM LOW SALINE FILTER FEED PUMPS — FE/FIT-51403 — PLC-4

3 FIC 56013A

1 UIC 56013A

RIO-5 (PLC-4)

FUNCTIONAL CONTROL DESCRIPTION NOTES:

1. STOP METERING PUMPS IF ALL ENABLED BULK STORAGE TANK LEVELS FALL BELOW A SCADA-ADJUSTABLE LOW LEVEL SET-POINT. THE "READY" SIGNAL SHALL BE GENERATED WHEN THE PUMP IS IN REMOTE MODE AND NO ASSOCIATED FAULT CONDITIONS ARE ACTIVE.
2. IN REMOTE AUTO, MODULATE DUTY METERING PUMP SPEED TO MAINTAIN A RATIO OF SODIUM HYPOCHLORITE TO REUSE WATER FLOW (FEED FORWARD CONTROL) AND TRIM RATIO BASED ON CHLORINE RESIDUAL (FEEDBACK CONTROL).
3. IN REMOTE AUTO, MODULATE DUTY METERING PUMP SPEED TO MAINTAIN A RATIO OF SODIUM HYPOCHLORITE TO FLOW FROM LOW SALINE FILTERS FEED PUMPS (FEED FORWARD CONTROL).

NOTES:

1. ALL BALL VALVES FOR SODIUM HYPOCHLORITE SERVICE SHALL BE VENTED TYPE CPVC BALL VALVES. REFER TO VALVE SCHEDULE IN MECHANICAL SPECIFICATIONS FOR MORE INFORMATION.

ES 120/1

SODIUM HYPOCHLORITE PUMP SKID LOCAL CONTROL PANEL — LCP-56016

	SPEED CMD/FBCK	PMP-1 ALARM	L/O/R	SPEED CMD/FBCK	PMP-2 ALARM
	SIC 56016	YA 56016	HS 56016	SIC 56616	YA 56616

RUNNING | FAULT | RUN COMMAND | SPEED COMMAND | CALCULATED FLOW CAPACITY

PI 56016 — MP-56016 PUMP No.1

PI 56616 — MP-56616 PUMP No.2

V

BACKPRESSURE REGULATOR TYP.

SH I-03 — FROM BULK STORAGE TANKS

CHLORINE CONTACT BASINS REUSE SYSTEM METERING PUMP SKID

SH I-08 — TO REUSE CCT DOSING STATION

ES 120/1

SODIUM HYPOCHLORITE PUMP SKID LOCAL CONTROL PANEL — LCP-56013A

	SPEED CMD/FBCK	PMP-1 ALARM	L/O/R	SPEED CMD/FBCK	PMP-2 ALARM
	SIC 56013A	YA 56013A	HS 56013A	SIC 56613A	YA 56613A

RUNNING | FAULT | RUN COMMAND | SPEED COMMAND | CALCULATED FLOW CAPACITY

PI 56013 — MP-56013A PUMP No.1

PI 56613 — MP-56613A PUMP No.2

V

BACKPRESSURE REGULATOR TYP.

SH I-03 — FROM BULK STORAGE TANKS

REUSE SYSTEM PRE-CHLORINATION METERING PUMP SKID

SH — PRE-CHLORINATION REUSE SYSTEM

CONTAINMENT AREA

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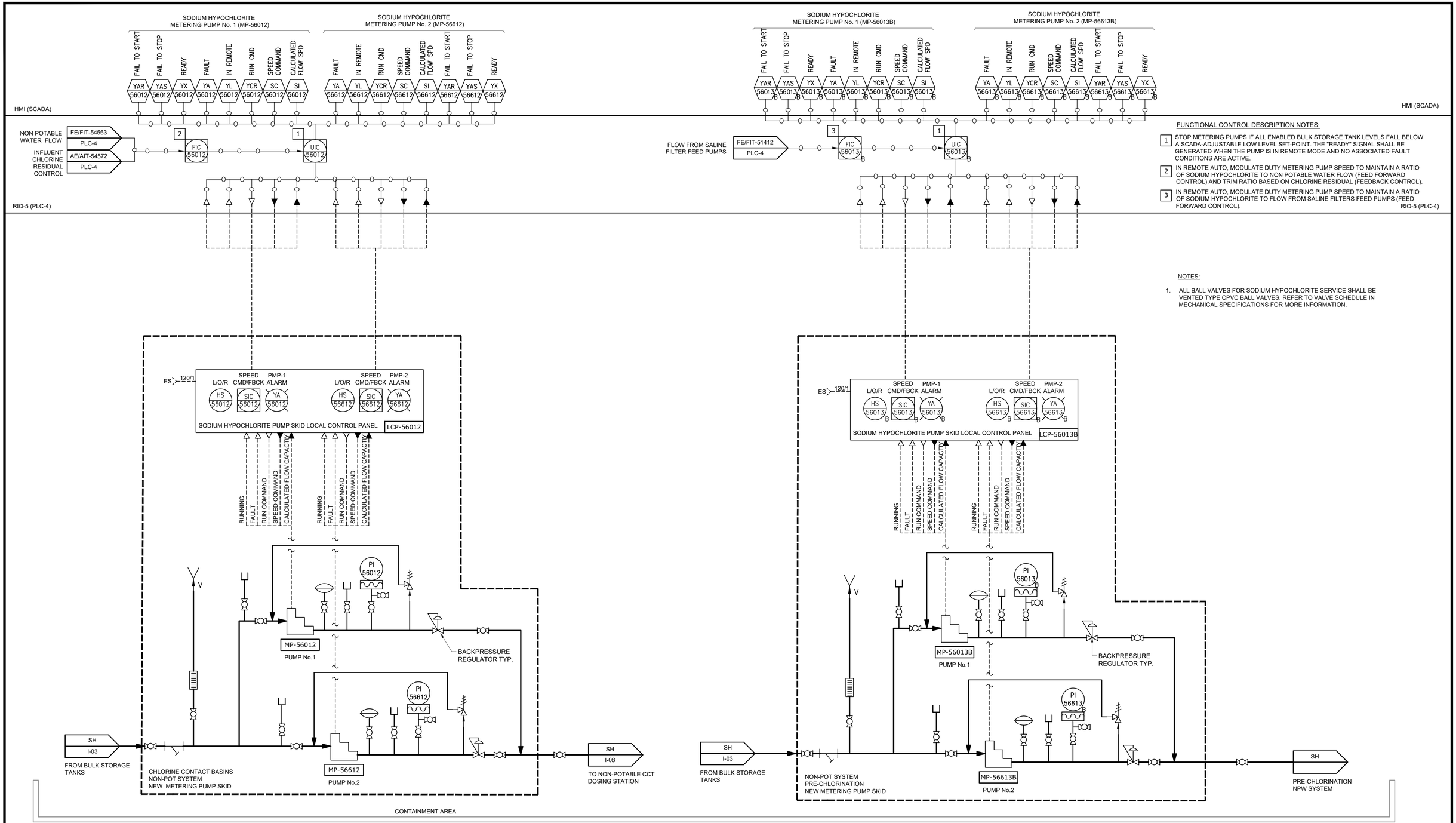
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SODIUM HYPOCHLORITE
TEMPORARY STORAGE AND FEED SYSTEM

INSTRUMENTATION
SODIUM HYPOCHLORITE FEED SYSTEM
P&ID - SHEET 1

DATE:	DECEMBER 2025
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CONTRACT NO.:	22-8073
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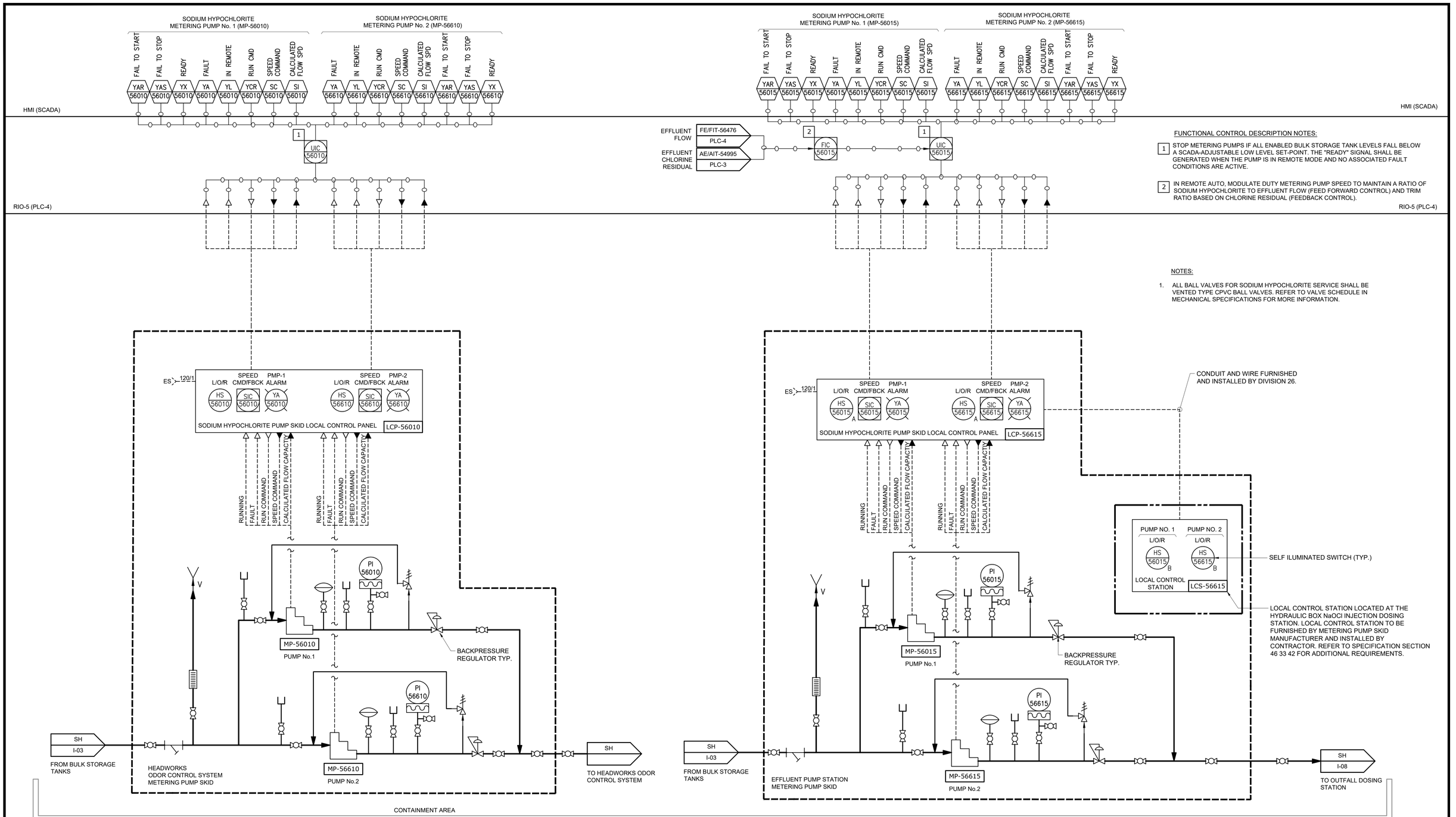
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SODIUM HYPOCHLORITE
TEMPORARY STORAGE AND FEED SYSTEM

INSTRUMENTATION
SODIUM HYPOCHLORITE FEED SYSTEM
P&ID - SHEET 2

DATE:	DECEMBER 2025
HAZEN NO.:	4321-111
CONTRACT NO.:	22-8073
DRAWING NUMBER:	I-05

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HOLLYWOOD, FLORIDA

SODIUM HYPOCHLORITE
TEMPORARY STORAGE AND FEED SYSTEM

INSTRUMENTATION
SODIUM HYPOCHLORITE FEED SYSTEM
P&ID - SHEET 3

DATE:	DECEMBER 2025
HAZEN NO.:	4321-111
CONTRACT NO.:	22-8073
DRAWING NUMBER:	I-06

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SODIUM HYPOCHLORITE METERING PUMP No. 1 (MP-56009)

FAULT YA 56009 | IN REMOTE YL 56009 | RUN CMD YCR 56009 | SPEED COMMAND SC 56009 | CALCULATED FLOW SPD SI 56009 | FAIL TO START YAR 56009 | FAIL TO STOP YAS 56009 | READY YX 56009

SODIUM HYPOCHLORITE METERING PUMP No. 1 (MP-56011)

FAULT YA 56011 | IN REMOTE YL 56011 | RUN CMD YCR 56011 | SPEED COMMAND SC 56011 | CALCULATED FLOW SPD SI 56011 | FAIL TO START YAR 56011 | FAIL TO STOP YAS 56011 | READY YX 56011

SODIUM HYPOCHLORITE TRABSFER PUMP (TP-56001)

LOW FLOW ALARM FAL 56001 | RUNNING YLR 56001 | OVERLOAD FAULT YA 56001 | IN REMOTE YL 56001 | ENB TRANSFER XC 56001 | START/STOP YCR 56001 | FAIL TO START YAR 56001 | FAIL TO STOP YAS 56001

HMI (SCADA)

TOTAL RAS FLOW — FE/FIT-56452 — PLC-5

2 FIC 56009 — 1 UIC 56009

INFLUENT FLOW — FE/FIT-56457 — PLC-6

3 FIC 56011 — 1 UIC 56011

4 UIC 56001

RIO-5 (PLC-4)

FUNCTIONAL CONTROL DESCRIPTION NOTES:

1. STOP METERING PUMPS IF ALL ENABLED BULK STORAGE TANK LEVELS FALL BELOW A SCADA-ADJUSTABLE LOW LEVEL SET-POINT. THE "READY" SIGNAL SHALL BE GENERATED WHEN THE PUMP IS IN REMOTE MODE AND NO ASSOCIATED FAULT CONDITIONS ARE ACTIVE.
2. IN REMOTE AUTO, MODULATE DUTY METERING PUMP SPEED TO MAINTAIN A RATIO OF SODIUM HYPOCHLORITE TO TOTAL RAS FLOW (FEED FORWARD CONTROL) . HMI (SCADA)
3. IN REMOTE AUTO, MODULATE DUTY METERING PUMP SPEED TO MAINTAIN A RATIO OF SODIUM HYPOCHLORITE TO INFLUENT FLOW (FEED FORWARD CONTROL) .
4. TRANSFER PUMP SHALL STOP IF A MAX. FILL OR HIGH-HIGH LEVEL CONDITION IS DETECTED IN ANY OF THE SELECTED DESTINATION TANKS, OR IF A LOW-LOW LEVEL CONDITION IS DETECTED IN ANY OF THE SELECTED SOURCE TANKS, OR IF THE PUMP IS RUNNING BUT NO FLOW IS DETECTED BY FSL-56001. RIO-5 (PLC-4)

NOTES:

1. ALL BALL VALVES FOR SODIUM HYPOCHLORITE SERVICE SHALL BE VENTED TYPE CPVC BALL VALVES. REFER TO VALVE SCHEDULE IN MECHANICAL SPECIFICATIONS FOR MORE INFORMATION.
2. SEE THERMAL DISPERSION FLOW SWITCH INSTALLATION DETAIL ON I-10.

HARDWIRED INTERLOCKS:

* STOP TRANSFER PUMP AND ISSUE A LOW FLOW ALARM WHEN TRANSFER PUMP IS CALLED TO RUN BUT NO FLOW IS DETECTED BY FSL-56001 FOR A 30 SEC TIME DELAY. WHEN THE HOR SELECTOR SWITCH IS PLACED IN THE "HAND" POSITION, THE TRANSFER PUMP SHALL NOT OPERATE UNLESS AN ENABLE SIGNAL HAS BEEN RECEIVED FROM SCADA (PLC-4).

ES 120/1 — SPEED CMD/FBCK HS 56009 / SIC 56009 — PMP-1 ALARM YA 56009

SODIUM HYPOCHLORITE PUMP SKID LOCAL CONTROL PANEL — LCP-56009

ES 120/1 — SPEED CMD/FBCK HS 56011 / SIC 56011 — PMP-1 ALARM YA 56011

SODIUM HYPOCHLORITE PUMP SKID LOCAL CONTROL PANEL — LCP-56011

ES 480/3 — ALARM/RESET HS 56001 — H/O/R HS 56001 — RUNNING YL 56001 — * MS — FLOW ALARM FAL 56001 — FAULT YA 56001

SODIUM HYPOCHLORITE TRANSFER LOCAL CONTROL PANEL — LCP-56001

CONSTRUCTION PER DETAIL ON I-11

RUNNING, FAULT, RUN COMMAND, SPEED COMMAND, CALCULATED FLOW CAPACITY

V — PI 56009 — MP-56009 — PUMP No.1 — BACKPRESSURE REGULATOR TYP.

SH I-03 — FROM BULK STORAGE TANKS

SH — TO RAS LINES 1-5

RAS PUMP STATION METERING PUMP SKID

V — PI 56011 — MP-56011 — PUMP No.1 — BACKPRESSURE REGULATOR TYP.

SH I-03 — FROM BULK STORAGE TANKS

SH — TO INFLUENT PUMP STATION

INFLUENT PUMP STATION METERING PUMP SKID

SH I-03 — FROM BST NO. 1

SH I-03 — FROM BST NO. 2

SH I-03 — FROM BST NO. 3

SH I-03 — FROM BST NO. 4

SH I-03 — FROM BST NO. 5

SH I-03 — FROM BST NO. 6

NOTE 2

ES 120/1 — FSL 56001 — M — TP-56001 — PUMP No.1

SH I-03 — TO BST No. 1

SH I-03 — TO BST No. 2

SH I-03 — TO BST No. 3

SH I-03 — TO BST No. 4

SH I-03 — TO BST No. 5

SH I-03 — TO BST No. 6

CONTAINMENT AREA

REV	ISSUED FOR	DATE	BY

PROJECT ENGINEER:	J. BOWDAN
DESIGNED BY:	AJM
DRAWN BY:	AJM
CHECKED BY:	EPC

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE — 0 1/2" 1"

Hazen

HAZEN AND SAWYER
4000 HOLLYWOOD BLVD SUITE 750N
HOLLYWOOD, FL 33021

CITY OF HOLLYWOOD
HOLLYWOOD, FLORIDA

SODIUM HYPOCHLORITE
TEMPORARY STORAGE AND FEED SYSTEM

INSTRUMENTATION
SODIUM HYPOCHLORITE FEED & TRANSFER SYSTEM P&ID

DATE:	DECEMBER 2025
HAZEN NO.:	4321-111
CONTRACT NO.:	22-8073
DRAWING NUMBER:	I-07

File: C:\USERS\LGONZALEZ\APPDATA\LOCAL\AUTODESK\AUTOCAD PLANT 3D\COLLABORATION\CACHE\4321-111 CITY OF HOLLYWOOD TEMPORARY SODIUM HYPO SYSTEM\PID DWG\4321-111-I07 Saved by LGONZALEZ Save date: 8/11/2025 4:30 PM
PLOT DATE: 8/11/2025 4:33 PM BY: LGONZALEZ

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PLOT DATE: 8/11/2025 4:33 PM BY: LGONZALEZ

FLOW ALARM HIGH FAH 65421
FLOW ALARM HIGH FAH 65422
FLOW ALARM HIGH FAH 65423
FLOW ALARM HIGH FAH 65424
FLOW ALARM HIGH FAH 65425
LEVEL ALARM HIGH LAH 56015
LEVEL ALARM HIGH LAH 56016

HMI (SCADA)

RIO-5 (PLC-4)

120/1 ES
FSH 65421
BULK STORAGE AREA
EYEWASH/SHOWER NO. 1
EW-65421

METERING PUMP SKIDS AREA
BULK STORAGE TANKS AREA

FSH 65422
BULK STORAGE AREA
EYEWASH/SHOWER NO. 2
EW-65422

FSH 65423
BULK STORAGE AREA
EYEWASH/SHOWER NO. 3
EW-65423

FSH 65424
BULK STORAGE AREA
EYEWASH/SHOWER NO. 4
EW-65424

FSH 65425
BULK STORAGE AREA
EYEWASH/SHOWER NO. 5
EW-65425

EYEWASH / SHOWERS

SH I-05
FROM NPW METERING PUMP SKID
FQI 56012
FI 56012
FI-56012
V
SH
TO NPW CCT

NPW
FROM NON-POTABLE WATER LINE
FQI 56016
FI 56016
FI-56016
V
SH
TO REUSE CCT
SH I-04
FROM REUSE WATER METERING PUMP SKID
LSH 56016

REUSE AND NPW CCT DOSING STATION (SUMP)

FQI 56015
FI 56015
FI-56015
V
SH
TO INJECTION WELL

NPW
FROM NON-POTABLE WATER LINE
SH I-06
FROM EFFLUENT PS METERING PUMP SKID
SH
TO OUTFALL PS
LSH 56015

OUTFALL DOSING STATION (SUMP)

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PROJECT ENGINEER:	J. BOWDAN
DESIGNED BY:	AJM
DRAWN BY:	AJM
CHECKED BY:	EPC

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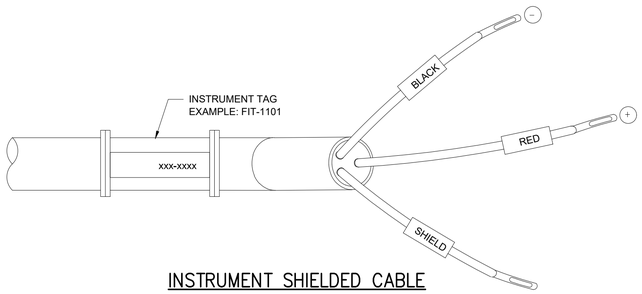
Hazen
HAZEN AND SAWYER
4000 HOLLYWOOD BLVD SUITE 750N
HOLLYWOOD, FL 33021

CITY OF HOLLYWOOD
HOLLYWOOD, FLORIDA

SODIUM HYPOCHLORITE
TEMPORARY STORAGE AND FEED SYSTEM

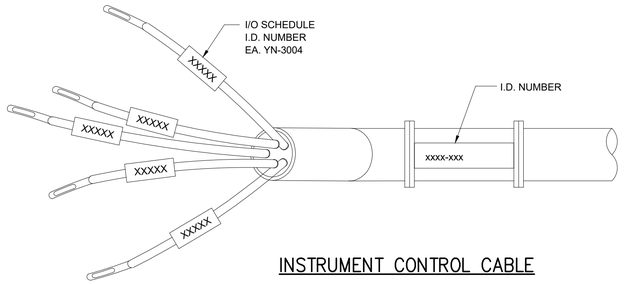
INSTRUMENTATION
MISCELLANEOUS P&ID

DATE:	DECEMBER 2025
HAZEN NO.:	4321-111
CONTRACT NO.:	22-8073
DRAWING NUMBER:	I-08



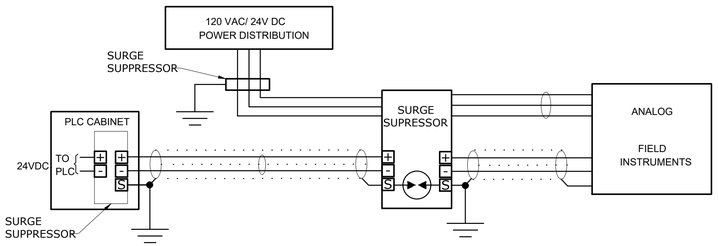
INSTRUMENT SHIELDED CABLE

N.T.S.

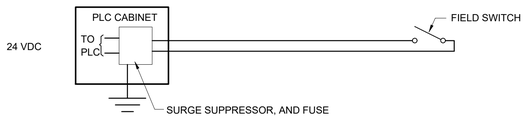


INSTRUMENT CONTROL CABLE

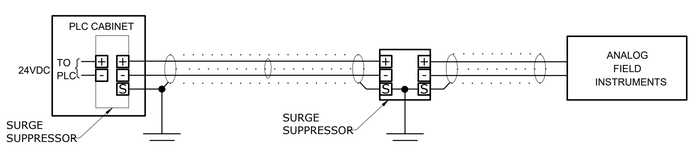
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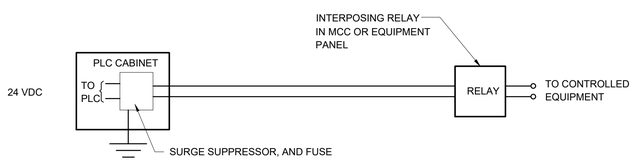
4-WIRE FIELD TRANSMITTERS (AC AND DC)



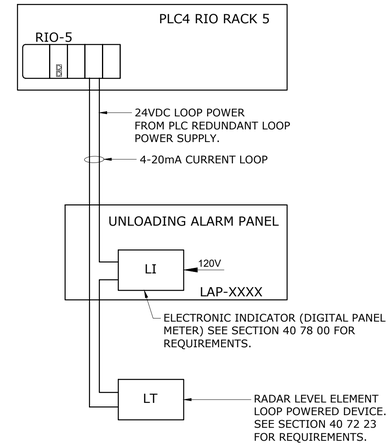
DISCRETE PLC/INPUT CIRCUIT



2-WIRE FIELD TRANSMITTERS (DC)



DISCRETE PLC/OUTPUT CIRCUIT



NOTES:

1. THIS DRAWING IS INTENDED TO SHOW THE BASIC 4-20mA CURRENT LOOP STRATEGY FOR THE RADAR LEVEL INSTRUMENTS. TERMINAL BLOCKS, FUSES, SURGE PROTECTION, SHIELDING, GROUNDING AND OTHER DIVISION 40 AND DIVISION 26 EQUIPMENT ARE NOT SHOWN.
2. CONTRACTOR SHALL SUBMIT TOTAL VOLTAGE DROP CALCULATIONS FOR ALL 4-20mA CURRENT LOOPS USED FOR PLC 24VDC LOOP POWER SUPPLY SIZING, PER SECTION XX XX XX.

TYPICAL CHEMICAL BULK STORAGE TANK
RADAR LEVEL 4-20 mA CURRENT LOOP

REV	ISSUED FOR	DATE	BY

PROJECT ENGINEER:	J. BOWDAN
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DRAWN BY:	AJM
CHECKED BY:	EPC

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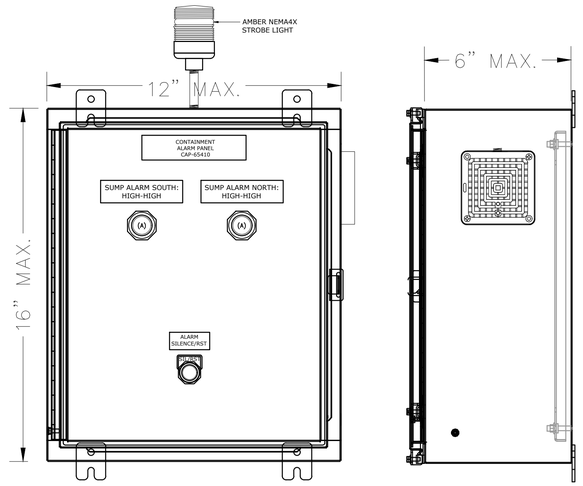
CITY OF HOLLYWOOD
HOLLYWOOD, FLORIDA

SODIUM HYPOCHLORITE
TEMPORARY STORAGE AND FEED SYSTEM

INSTRUMENTATION
TYPICAL DETAILS - SHEET 1

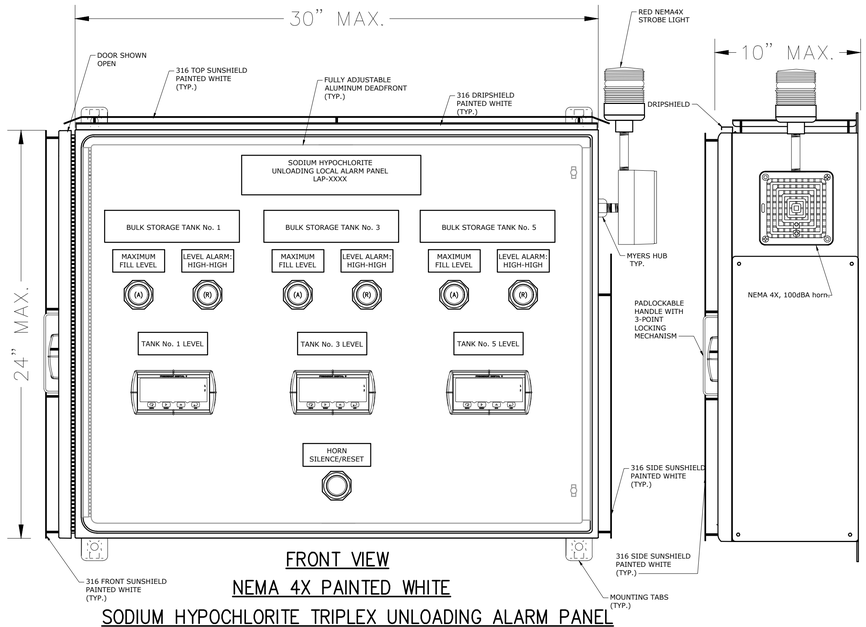
DATE:	DECEMBER 2025
HAZEN NO.:	4321-111
CONTRACT NO.:	22-8073
DRAWING NUMBER:	I-09

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CONTAINMENT ALARM PANEL

DETAIL	01
NTS	–



FRONT VIEW
NEMA 4X PAINTED WHITE

SODIUM HYPOCHLORITE TRIPLEX UNLOADING ALARM PANEL

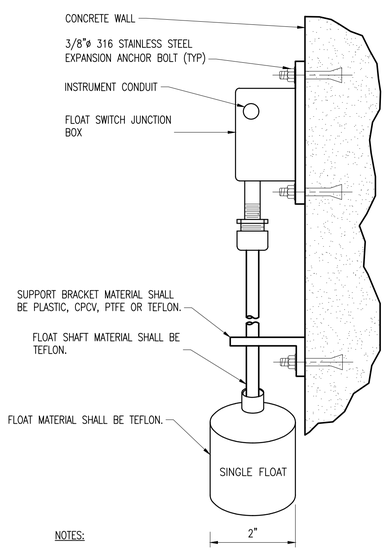
DETAIL	02
NTS	–

NOTES:

1. LOCAL ALARM PANEL ENCLOSURE SHALL BE NEMA 4X 316 STAINLESS STEEL PAINTED WHITE.
2. PROVIDE 316L SS SUN-SHIELDS THAT ENCLOSES THE TOP FRONT AND BOTH SIDES OF THE ALARM PANEL ENCLOSURE.
3. LOCAL ALARM PANEL SHALL BE EQUIPPED WITH A NAMEPLATE MOUNTED TO THE FRONT DOOR OF THE PANEL. PANEL NAMEPLATE SHALL READ AS FOLLOWS:

SODIUM HYPOCHLORITE
UNLOADING LOCAL ALARM PANEL
LAP-XXXX

XXXX TYPICAL FOR 65421 AND 65422

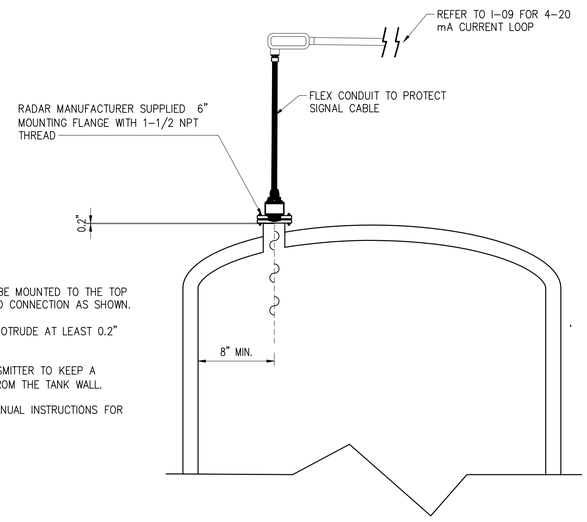


NOTES:

1. SEE SECTION 40 72 76.26 FOR ADDITIONAL REQUIREMENTS.

CHEMICAL CONTAINMENT SUMP SLIDING FLOAT SWITCH

DETAIL	03
NTS	–

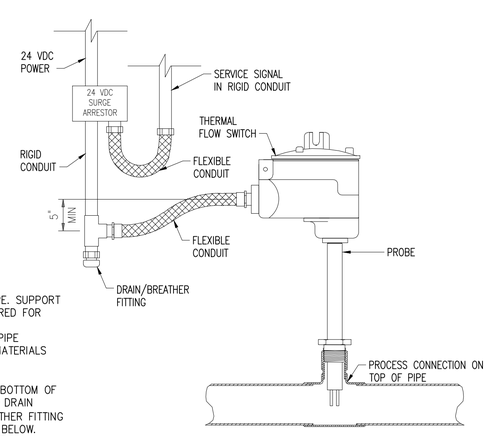


NOTES:

1. RADAR TRANSMITTER SHALL BE MOUNTED TO THE TOP OF THE TANK WITH THREADED CONNECTION AS SHOWN.
2. THE ANTENNA END SHALL PROTRUDE AT LEAST 0.2" OUT OF THE SOCKET.
3. MOUNT RADAR SENSOR/TRANSMITTER TO KEEP A DISTANCE OF AT LEAST 8" FROM THE TANK WALL.
4. REFER TO MANUFACTURER MANUAL INSTRUCTIONS FOR PROPER INSTALLATION.

RADAR TRANSMITTER MOUNT FOR VERTICAL BULK STORAGE TANKS

DETAIL	04
NTS	–



NOTES:

1. FLOW SWITCH SHALL NOT BE SUPPORTED BY PIPE. SUPPORT WITH PREFORMED CHANNEL, MATERIAL AS REQUIRED FOR LOCATION.
2. PVC PIPE SHOWN, WHEN INSTALLING ON OTHER PIPE MATERIALS, INSTALLATION IS SIMILAR.USE PIPE MATERIALS AS OTHERWISE REQUIRED.
3. SEAL THREADS WITH TEFLON TAPE.
4. INSTALL A DRAIN/BREATHER FITTING IN AT THE BOTTOM OF THE VERTICAL OR HORIZONTAL RUN CONDUIT TO DRAIN WATER FORMED BY CONDENSATION. DRAIN/BREATHER FITTING NOT REQUIRED WHEN CONDUIT IS ROUTED FROM BELOW.
5. MOUNT ON PIPE WITH PIPE SADDLE OR WELDOLET.
6. PROVIDE END MOUNTING HARDWARE FOR LOCAL FLOW ELEMENT ASSEMBLY AS REQUIRED BY MANUFACTURER.
7. COORDINATE PIPE PENETRATION SIZE WITH MANUFACTURER.
8. FASTENERS SHALL BE STAINLESS STEEL.
9. PROVIDE HOT TAP AS SCHEDULED.
10. PROVIDE SUFFICIENT FLEXIBLE CONDUIT ON POWER AND SIGNAL LINES SO THE FLOW METER CAN BE REMOVED FROM THE PIPE WITHOUT DETERMINATING WIRES FROM THE UNIT.

THERMAL DISPERSION LIQUID FLOW SWITCH

DETAIL	05
NTS	–

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PROJECT ENGINEER:	J. BOWDAN
DESIGNED BY:	AJM
DRAWN BY:	AJM
CHECKED BY:	EPC

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HOLLYWOOD, FL 33021

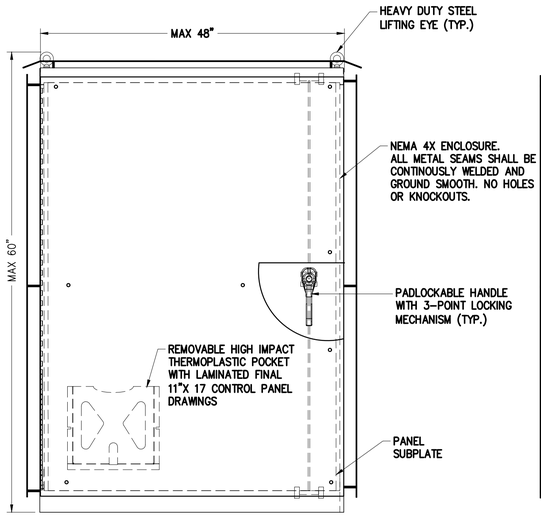
CITY OF HOLLYWOOD
HOLLYWOOD, FLORIDA

SODIUM HYPOCHLORITE
TEMPORARY STORAGE AND FEED SYSTEM

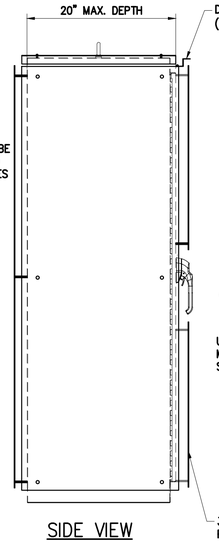
INSTRUMENTATION
TYPICAL DETAILS - SHEET 2

DATE:	DECEMBER 2025
HAZEN NO.:	4321-111
CONTRACT NO.:	22-8073
DRAWING NUMBER:	I-10

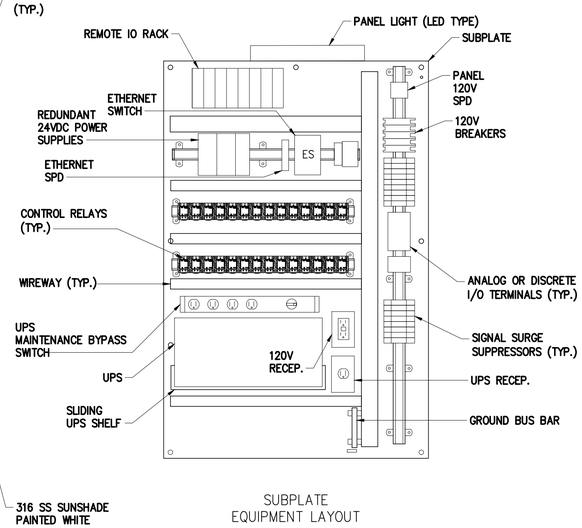
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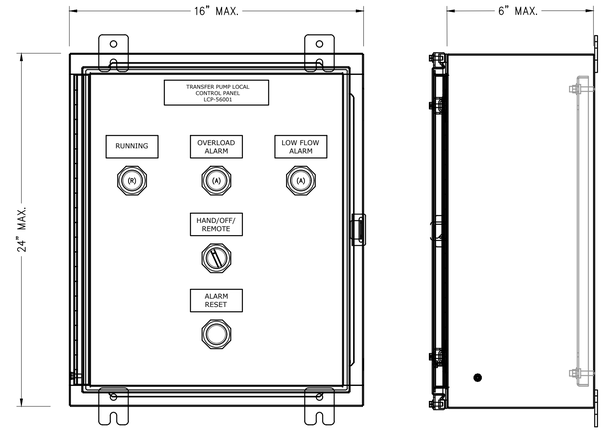
FRONT VIEW
NEMA 4X PAINTED WHITE



SIDE VIEW



SUBPLATE
EQUIPMENT LAYOUT

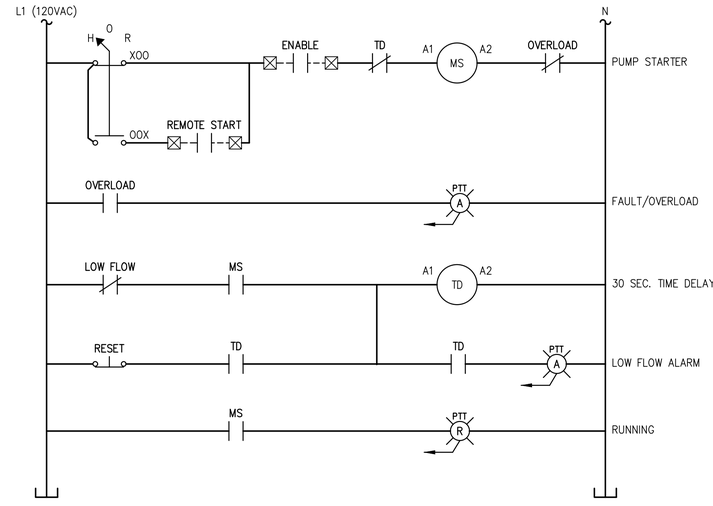


NOTES:

1. ENCLOSURE SHALL MEET ALL REQUIREMENTS OF THE APPLICABLE DIVISION 26 AND DIVISION 40 SPECIFICATIONS.
2. CONTRACTOR SHALL CAREFULLY PLAN AND EXECUTE CONDUIT STUB UP LOCATIONS AND PENETRATIONS IN BOTTOM OF ENCLOSURE. REMOVAL OF ENCLOSURE BOTTOM TO ACCOMMODATE CONDUITS IS NOT ACCEPTABLE.
3. PROVIDE PANEL INTRUSION SWITCH AND WIRE TO PLC INPUT.
4. PROVIDE SWITCH TO TURN PANEL LIGHT ON WHEN PANEL DOOR OPENS.
5. PROVIDE PANEL THERMOSTAT WIRED TO PLC INPUT TO MONITOR PANEL INTERIOR AIR TEMP.

LOCAL CONTROL PANEL (PLC4 RIO RACK 5)

DETAIL	06
NTS	–



TRANSFER PUMP LOCAL CONTROL PANEL (LCP-56001)

DETAIL	07
NTS	–

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CITY OF HOLLYWOOD
HOLLYWOOD, FLORIDA

SODIUM HYPOCHLORITE
TEMPORARY STORAGE AND FEED SYSTEM

INSTRUMENTATION
TYPICAL DETAILS - SHEET 3

DATE:	DECEMBER 2025
HAZEN NO.:	4321-111
CONTRACT NO.:	22-8073
DRAWING NUMBER:	I-11

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PLOT DATE: 8/11/2025 4:33 PM BY: LGONZALEZ

BASIC ELECTRICAL REQUIREMENTS:

1. SCOPE OF WORK

1.1. THE SCOPE OF WORK SHALL BE AS DESCRIBED IN SPECIFICATION SECTION 26 05 00.

1.2. THE CONTRACTOR SHALL OBTAIN ALL NECESSARY PERMITS, INSPECTIONS AND APPROVALS AND TO INCLUDE ALL FEES AS PART OF HIS BID IF NOT OTHERWISE NOTED.

1.3. THE CONTRACTOR SHALL, BEFORE SUBMITTING HIS BID, VISIT THE SITE OF THE PROJECT AND BECOME FAMILIAR WITH THE EXISTING CONDITIONS. NO ALLOWANCE WILL BE MADE FOR EXISTING CONDITIONS OR FAILURE OF THE CONTRACTOR TO OBSERVE THEM.

1.4. IT IS THE CONTRACTOR'S RESPONSIBILITY TO COORDINATE WITH ALL LOCAL UTILITIES, INCLUDING THE POWER AND TELEPHONE UTILITIES TO MEET ALL OF THEIR INSTALLATION REQUIREMENTS. ALL FEES, LABOR, EQUIPMENT OR MATERIALS NECESSARY TO MEET THESE REQUIREMENTS IS TO BE INCLUDED IN THE BID. THE CONTRACTOR SHALL OBTAIN, DELIVER AND INSTALL ALL CONDUITS, PULL-BOXES AND EQUIPMENT AS REQUIRED BY THE UTILITIES TO THEIR SPECIFICATIONS. THE TELEPHONE UTILITY REPRESENTATIVE IS THE CITY'S TELEPHONE CONTRACTOR.

1.5. THE CONTRACTOR SHALL COORDINATE HIS WORK WITH THE ENGINEER AND OWNER.

1.6. THE CONTRACTOR SHALL PROVIDE ALL MATERIALS AND LABOR TO INSTALL THE ELECTRICAL SYSTEMS AS INDICATED ON THE DRAWINGS. ITEMS NOT SHOWN BUT OBVIOUSLY NECESSARY FOR COMPLETION OF THE WORK SHALL BE INCLUDED.

1.7. ALL EQUIPMENT AND MATERIAL SHALL BE NEW, UNUSED AND U.L. LISTED. ALL REFERENCES TO A PARTICULAR MANUFACTURER ARE GIVEN ON AN "APPROVED EQUAL" BASIS.

1.8. THE CONTRACTOR IS RESPONSIBLE TO TEST ALL SYSTEMS INSTALLED OR MODIFIED UNDER THIS PROJECT AND REPAIR OR REPLACE ALL DEFECTIVE WORK TO THE SATISFACTION OF THE ENGINEER AND OWNER.

1.9. ALL EQUIPMENT FURNISHED AND INSTALLED BY THE CONTRACTOR SHALL BE GUARANTEED AGAINST DEFECTS IN MATERIAL AND WORKMANSHIP FOR A PERIOD OF ONE YEAR FROM DATE OF ACCEPTANCE UNLESS OTHERWISE NOTED.

1.10. SHOP DRAWINGS SHALL BE SUBMITTED FOR ALL ELECTRICAL & CONTROL EQUIPMENT AND MATERIAL.

2. CODES AND STANDARDS

2.1. THE INSTALLATION SHALL BE IN ACCORDANCE WITH THE MINIMUM FOLLOWING STANDARDS AND CODES:

2.2. NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

2.3. NATIONAL ELECTRICAL CODE (NEC) 2020 EDITION)

2.4. NATIONAL ELECTRICAL SAFETY CODE, (NFPA 70E 2024 EDITION) STANDARD FOR FIRE PROTECTION IN WASTEWATER TREATMENT AND COLLECTION FACILITIES, (NFPA 820 2024 EDITION)

2.5. OTHER NFPA CODES AS APPLICABLE

2.6. FLORIDA BUILDING CODE (FBC 2023 EDITION)

2.7. LOCAL CODES, CITY CODES REQUIRED BY THE AUTHORITY HAVING JURISDICTION.

2.8. AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

2.9. NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

2.10. INSTITUTE OF ELECTRICAL AND ELECTRONIC ENGINEERS (IEEE)

2.11. INSULATED CABLE ENGINEERS ASSOCIATION (ICEA)

2.12. OCCUPATIONAL SAFETY AHD HEALTH ACT (OSHA)

2.13. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

2.14. UNDERWRITERS LABORATORIES (UL) LISTING AND LABELING FOR ALL MATERIALS AND EQUIPMENT WHERE APPLICABLE STANDARDS EXIST

3. GENERAL ITEMS

3.1. ALL CIRCUITS SHALL BE IDENTIFIED IN JUNCTION BOXES, PULL BOXES....

3.2. ALL LOCATIONS OF EQUIPMENT, PANELS ETC. ARE SHOWN FOR ILLUSTRATION PURPOSES. CONTRACTOR SHALL VERIFY AND COORDINATE EXACT LOCATION AND SIZE WITH ALL SUBCONTRACTORS AND EQUIPMENT SUPPLIERS PRIOR TO ANY INSTALLATION AND THEN INSTALL AS SUCH WITH CORRESPONDING CONDUIT STUB-UPS.

3.3. SEE OTHER DISCIPLINE DRAWINGS FOR COORDINATION OF ALL DRAWINGS. ANY CONFLICTS SHALL BE BROUGHT TO THE ENGINEER'S ATTENTION AND MOVEMENT OF CONDUITS OR OTHER ELECTRICAL EQUIPMENT SHALL BE ACCOMPLISHED WITHOUT ANY ADDITIONAL COST FOR THE OWNER.

3.4. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ALL CONDUIT AND WIRING INSTALLATION FOR ALL VENDOR PROVIDED EQUIPMENT (PACKAGE SYSTEMS). IF THE SHOP DRAWINGS DIFFER FROM THE DESIGNED FACILITIES, THE CONTRACTOR SHALL REDESIGN THE FACILITIES AND SUBMIT THE REVISED DESIGN FOR THE ENGINEER'S APPROVAL ALONG WITH THE SHOP DRAWINGS. THERE SHALL BE NO ADDITIONAL COST TO THE OWNER FOR THE REDESIGN NOR FOR ANY ADDITIONAL CONDUITS AND WIRING. DURING SUBMITTAL THE CONTRACTOR SHALL VERIFY ALL SUPPLIED BREAKER SIZES FOR ALL PACKAGED SYSTEMS SUCH AS HVAC, EXHAUST FANS, MIXERS, CHEMICAL PUMPS ETC. AND MODIFY ALL BREAKERS IN MCC'S AND PANELBOARDS ACCORDINGLY WITHOUT ANY ADDITIONAL COST TO THE OWNER.

3.5. CONTRACTOR SHALL RESTORE SIDEWALKS, ROADWAYS, SOD AND SPRINKLER SYSTEM PIPING TO MATCH EXISTING, AFTER THE COMPLETION OF THE CONDUIT AND PULLBOX INSTALLATION.

3.6. ELECTRICAL EQUIPMENT SHALL BE DEFINED AS ANY ELECTRICAL DEVICE USED IN CONJUNCTION WITH OTHER EQUIPMENT REQUIRING ELECTRICITY FOR OPERATION. THIS INCLUDES BUT IS NOT LIMITED TO: DISCONNECT SWITCHES, JUNCTION BOXES, PANELBOARDS, TRANSFORMERS, LIGHTING FIXTURES, MOTOR STARTERS, SWITCHGEAR, MOTOR CONTROL CENTERS, CONTROLS, LOCAL CONTROL PANELS.

3.7. ALL REFERENCES TO STAINLESS STEEL (SS) SHALL MEAN TYPE 316 STAINLESS STEEL UNLESS OTHERWISE NOTED.

3.8. ALL ELECTRICAL EQUIPMENT IN DESIGNATED CORROSIVE AREAS SHALL BE NEMA 4X 316 STAINLESS STEEL OR NON-METALLIC (FRP).

3.9. OUTDOOR LIGHTING FIXTURES SHALL BE COPPER FREE ALUMINUM.

3.10. CONTRACTOR SHALL PROVIDE AS PART OF THE ELECTRICAL SUBMITTAL, A LAYOUT OF THE ELECTRICAL ROOM SHOWING SIZES OF ALL EQUIPMENT INCLUDING LIGHTING, AND HVAC WITH THEIR SPATIAL RELATIONSHIPS.

3.11. CONTRACTOR SHALL PROVIDE AND INSTALL WIRE ID TAGS ON ALL WIRING THAT INTERFACES WITH OTHER EQUIPMENT. INSTRUMENTATION WIRING SHALL BE AS SHOWN FOR THE DFS SCHEDULE ON DRAWING ###.

4. OPERATION AND MAINTENANCE MANUALS

4.1. CONTRACTOR SHALL PROVIDE AN OPERATION AND MAINTENANCE MANUAL PER FBC EC C405.7.4.2 INCLUDING:

4.1.1. SUBMITTAL DATA STATING EQUIPMENT RATING AND SELECTED OPTION FOR EACH PIECE OF EQUIPMENT REQUIRING MAINTENANCE.

4.1.2. OPERATION AND MAINTENANCE MANUALS FOR EACH PIECE OF EQUIPMENT REQUIRING MAINTENANCE. REQUIRED ROUTINE MAINTENANCE ACTIONS SHALL BE CLEARLY IDENTIFIED

4.1.3. NAMES AND ADDRESSES OF AT LEAST ONE QUALIFIED SERVICE AGENCY SEE SPECIFICATIONS FOR ADDITIONAL DETAILS

5. PROJECT CLOSEOUT

5.1. CONTRACTOR SHALL PROVIDE RECORD DRAWINGS TO THE OWNER AND ENGINEER WITHIN 30 DAYS OF PUMP STATION ACCEPTANCE. THESE SHALL INCLUDE PER FBC EC C405.7.4.1:

5.2. A LAMINATED AND FRAMED MINIMUM 11X17 INCH SINGLE LINE DIAGRAM OF THE SITE ELECTRICAL SYSTEM SHALL BE PROVIDED FOR INSTALLATION ADJACENT TO THE MAIN ELECTRICAL GEAR.

5.3. PLAN VIEWS OF COMPLETE PUMP STATION

6. RACEWAYS:

6.1. CONDUITS RUN IN PARALLEL: INSTRUMENTATION CONDUITS SHALL HAVE A MINIMUM SEPARATION FROM POWER CONDUITS AS INDICATED IN TABLE WHETHER CONCRETE ENCASED DUCT BANKS, DIRECT BURIED, SURFACE OR RACKS:

	VOLTAGE	DISTANCE
6.1.1.	4160V	3 FT
6.1.2.	480V	2 FT
6.1.3.	120V	1 FT

6.2. NOT ALL CONDUITS SHOWN ON RISER AND ONE-LINE DIAGRAMS ARE SHOWN ON BUILDING LAYOUTS. CONTRACTOR SHALL SUPPLY ALL CONDUITS AND CABLES AS SHOWN ON RISERS AND ONE-LINE DIAGRAMS.

6.3. EXPOSED RUNS OF CONDUITS SHALL BE INSTALLED WITH RUNS PARALLEL OR PERPENDICULAR TO WALLS, STRUCTURAL MEMBERS OR INTERSECTIONS OF VERTICAL PLANES AND CEILINGS, WITH RIGHT ANGLE TURNS CONSISTING OF SYMMETRICAL BENDS OR PULL BOXES AS INDICATED ON THE DRAWINGS. BENDS AND OFFSETS SHALL BE AVOIDED WHERE POSSIBLE.

6.4. THE DRAWINGS ARE NOT INTENDED TO SHOW THE EXACT LOCATION OF CONDUIT RUNS. THESE ARE TO BE COORDINATED WITH THE OTHER TRADES SO THAT CONFLICTS ARE AVOIDED PRIOR TO INSTALLATIONS.

6.5. CONTRACTOR SHALL CORE DRILL EXISTING CONCRETE WALLS, FLOORS, MANHOLES, HAND HOLES AND PULL BOXES FOR CONDUIT PENETRATIONS. SEAL PENETRATIONS WITH NON-SHRINK GROUT OR APPROPRIATE FIRE RATED DEVICES WHERE APPLICABLE.

6.6. ALL CONDUITS PENETRATING RATED FIRE WALLS OR RATED FIRE FLOORS SHALL BE INSTALLED WITH U.L. APPROVED DEVICES AND OR FIRE RATED SEALING COMPOUND TO MAINTAIN THE FIRE RATING OF THE WALL OR FLOOR PENETRATED.

6.7. PROVIDE CONDUIT DUCT SEAL AT ALL CONDUIT ENDS.

6.8. ALL SPARE, ABANDONED, OR EMPTY CONDUITS SHALL BE SEALED WITH A CAP AT BOTH ENDS AND A PULL STRING INSTALLED WITH IDENTIFICATION OF OTHER END LOCATION AT BOTH ENDS.

6.9. FLEXIBLE CONDUITS SHALL BE USED TO TERMINATE ALL MOTORS AND OTHER VIBRATING EQUIPMENT AND SHALL BE BETWEEN 18" AND 36" IN LENGTH.

6.10. ALL METALLIC CONDUITS BELOW GRADE TO A MINIMUM ELEVATION OF 12 INCHES ABOVE GRADE SHALL BE PVC COATED RIGID METAL CONDUIT (RMC).

6.11. ALL METALLIC CONDUITS 12 INCHES AND GREATER ABOVE GRADE SHALL BE RMC.

6.12. ALL REFERENCES TO RMC SHALL MEAN RIGID ALUMINUM CONDUIT (AL) UNLESS OTHERWISE NOTED.

6.13. ALL REFERENCES TO PVC COATED RMC SHALL MEAN PVC COATED RIGID ALUMINUM CONDUIT (AL) UNLESS OTHERWISE NOTED.

6.14. ALL ANALOG SIGNAL WIRING SHALL BE RUN IN GALVANIZED RIGID CONDUIT (GRC)

7. DUCT BANKS & MANHOLES

7.1. LOCATIONS OF MANHOLES, HANDHOLES AND PULL BOXES ARE APPROXIMATE. CONTRACTOR SHALL COORDINATE EXACT LOCATION WITH EXISTING AND NEW PIPING OR CONDUIT AND ADJUST ACCORDINGLY.

7.2. COLORED WARNING TAPE 6" WIDE SHALL BE INSTALLED 8" BELOW FINISHED GRADE DIRECTLY ABOVE ALL UNDERGROUND YARD CONDUITS ACCORDING TO THE FOLLOWING SCHEDULE:

7.2.1. POWER: RED

7.2.2. ALL OTHER CONDUITS: GREEN

7.3. ALL EXCAVATIONS FOR CONDUITS, HANDHOLES, MANHOLES AND PULLBOXES NEAR EXISTING PIPING, CONDUIT AND EQUIPMENT SHALL BE HAND EXCAVATED AND COORDINATED WITH PLANT ENGINEER.

7.4. MINIMUM DEPTH FROM TOP OF DUCT BANKS OR CONDUITS TO FINISHED GRADE SHALL BE 24" UNLESS OTHERWISE NOTED.

7.5. IF CONCRETE ENCASED DUCT BANKS INCLUDE POWER WITH ANY TYPE OF SIGNALS EXCEPT FIBER OPTIC CABLE, ALL CONDUITS SHALL BE METALLIC.

7.6. CONCRETE DUCT BANKS WITH POWER ONLY WIRING MAY BE PVC UNLESS OTHERWISE NOTED ON THE DRAWINGS.

7.7. SLOPE DUCT BANKS A MINIMUM 3 INCHES PER 100 FEET DOWN AWAY FROM BUILDINGS.

7.8. DUCT BANK CONCRETE SHALL BE MINIMUM CLASS C 2500 PSI

8. CONDUCTORS:

8.1. ALUMINUM CONDUCTORS SHALL NOT BE USED FOR THIS PROJECT.

8.2. CONDUCTOR PULLING TENSIONS SHALL NOT EXCEED MANUFACTURER'S RECOMMENDATION. CONTRACTOR SHALL INSTALL PULL BOXES TO MEET MANUFACTURER'S REQUIREMENTS.

8.3. COPPER CONDUCTORS FOR POWER WIRING WITH A VOLTAGE GREATER THAN 240V TO GROUND SHALL BE XHHW-2. OTHER POWER WIRING SHALL BE EITHER XHHW OR THWN STRANDED COPPER WIRING.

8.4. BRANCH CIRCUITS EXCEEDING 100 FT IN LENGTH SHALL BE WIRED WITH MINIMUM #10 AWG COPPER WIRES. CONTRACTOR SHALL VERIFY REQUIRED WIRE SIZE WITH VOLTAGE DROP CALCULATIONS.

9. BOXES

9.1. ALL ENCLOSURES, TJB, WIREWAY, PULL BOXES ETC. SHALL CONTAIN A GROUNDING BUS. CONNECT ALL RACEWAY BONDS TO THIS BUS VIA GROUNDING BUSHING AND EXTEND BONDING JUMPER FROM THIS BUS TO THE ENCLOSURE.

9.2. ALL JUNCTIONS BOXES, LOCAL CONTROL PANELS, DISCONNECT SWITCHES AND INSTALLATION HARDWARE INSTALLED OUTDOORS OR INDOORS WET AREAS SHALL BE 316 STAINLESS STEEL.

10. PANELS

10.1. ALL CONTROL PANELS SHALL BE CONSTRUCTED BY A UL 508A APPROVED PANEL VENDOR AND SHALL BEAR A UL 508A LABEL ON THE PANEL.

10.2. PANELS INSTALLED OUTDOORS OR IN WET INDOOR AREAS SHALL BE IN NEMA 4X 316 STAINLESS STEEL ENCLOSURES.

10.3. TYPEWRITTEN AND LAMINATED PANEL SCHEDULES SHALL BE INSTALLED IN EACH PANELBOARD, AND TYPEWRITTEN TERMINAL BLOCK SCHEDULES IN EACH CONTROL CABINET.

10.4. ALL PANELBOARDS SHALL INCLUDE AN INTEGRAL FACTORY INSTALLED SURGE PROTECTION DEVICES (SPD AKA TVSS).

10.5. CONTRACTOR SHALL BALANCE PANELBOARD LOADS AT THE END OF THE PROJECT.

11. GROUNDING

11.1. GROUNDING SHALL BE INSTALLED IN ACCORDANCE WITH NEC, ARTICLE 250. THE GROUNDING SYSTEM TEST SHALL NOT EXCEED A 48 HOUR SPAN DRY RESISTANCE OF 10 OHMS. ADDITIONAL GROUNDING TO MEET THIS REQUIREMENT SHALL BE INSTALLED AT NO EXTRA COST. GROUNDING AND BONDING CONNECTIONS SHALL NOT BE PAINTED. ALL GROUNDING CONNECTIONS SHALL BE EXOTHERMIC UNLESS SPECIFICALLY INDICATED OTHERWISE.

11.2. AN EQUIPMENT GROUND WIRE SIZED PER NEC SHALL BE PULLED IN ALL ELECTRICAL CONDUITS, POWER AND CONTROL, WHETHER OR NOT INDICATED ON THE PLANS.

12. INSTRUMENTATION

12.1. INSTRUMENTATION IS LOW VOLTAGE SIGNALS SUCH AS 4-20MA, TELEPHONE COMMUNICATION, FIRE ALARM COMMUNICATION. POWER CONDUITS SHALL ONLY CROSS INSTRUMENTATION CONDUIT PERPENDICULARLY AT RIGHT ANGLES WITH 6" SEPARATION.

12.2. THE POWER AND SIGNAL SIDES OF ALL EXTERIOR INSTALLED INSTRUMENTATION SHALL HAVE SURGE PROTECTION AND SHALL BE GROUNDED TO A SEPARATE GROUND ROD AT THE INSTRUMENT.

12.3. INSTRUMENTATION GROUND SHALL BE A #6 AWG COPPER CONNECTED TO THE GROUND GRID OR CONNECTED TO A DRIVEN GROUND. #6 GROUND WIRE SHALL BE INSTALLED IN CONDUIT WHERE EXPOSED. GROUND RODS SHALL BE 5/8" OR 3/4" BY A MINIMUM OF 20' IN LENGTH, AS INDICATED ON THE DRAWINGS.

12.4. CONTRACTOR SHALL INSTALL A SWITCH TO DISCONNECT POWER AT EACH FOUR WIRE INSTRUMENT. ALL INSTRUMENTATION WIRING SHALL BE TERMINATED, LOOP TESTED LOCALLY AND BETWEEN THE BASE STATION AND LOCAL PUMP STATION PRIOR TO FINAL STARTUP AND ACCEPTANCE.

13. SIGNAGE

13.1. CONTRACTOR SHALL PROVIDE SIGNAGE PER NEC 110.24 AND NEC 702.7 AT THE SERVICE ENTRANCE EQUIPMENT.

13.2. CONTRACTOR SHALL PROVIDE SIGNAGE PER NFPA 110 FOR THE EMERGENCY SHUT-OFF BUTTON LOCATED ON THE NORTH EAST OUTSIDE CORNER OF THE ELECTRICAL BUILDING.

13.3. CONTRACTOR SHALL PROVIDE SIGNAGE PER NFPA 704 FOR THE FUEL SUPPLY.

13.4. CONTRACTOR SHALL PROVIDE AND INSTALL ARC-FLASH HAZARD WARNING LABELS PER NEC 110.16 AND 110.21. THESE RULES APPLY AS A MINIMUM TO SWITCHBOARDS, SWITCHGEAR, PANELBOARDS, MOTOR CONTROL CENTERS, INDUSTRIAL CONTROL PANELS, METER SOCKET ENCLOSURES, AND ENCLOSED CIRCUIT BREAKERS.

14. ELECTRICAL DEVICES (SW AND RECP)

14.1. ALL RECEPTACLES SHALL BE INSTALLED 18" AFF UNLESS OTHERWISE NOTED. LIGHT SWITCHES SHALL BE MOUNTED 48" AFF UNLESS OTHERWISE NOTED.

14.2. ALL RECEPTACLES WITHIN 6' OF A SINK SHALL BE GFI.

14.3. CONTRACTOR SHALL PROVIDE, INSTALL, TERMINATE AND TEST NEW STATION SCADA EQUIPMENT.

REV	ISSUED FOR	DATE	BY

PROJECT ENGINEER:	J. BOWDAN
DESIGNED BY:	J. BROAD
DRAWN BY:	J. BROAD
CHECKED BY:	J. BURKE

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE 0 1/2" 1"

Hazen
HAZEN AND SAWYER
4000 HOLLYWOOD BLVD SUITE 750N
HOLLYWOOD, FL 33021

CITY OF HOLLYWOOD
HOLLYWOOD, FLORIDA

SODIUM HYPOCHLORITE
TEMPORARY STORAGE AND FEED SYSTEM

ELECTRICAL
GENERAL NOTES

DATE:	DECEMBER 2025
HAZEN NO.:	4321-111
CONTRACT NO.:	22-8073
DRAWING NUMBER:	E-01

File: C:_DC\ACCDOCS\HAZEN AND SAWYER\04321-111\PROJECT FILES\1-DESIGN\01-HAZENELEC\04321-111-E01 Saved by JBROAD Save date: 8/7/2025 3:28 PM
PLOT DATE: 8/14/2025 2:11 PM BY: JBROAD

ABBREVIATIONS

ABBR.	DESCRIPTION
A	AMMETER, AMPERE
AB	ALARM BELL
AC	ALTERNATING CURRENT
AF	CB AMPERE FRAME SIZE
AFD	ADJUSTABLE FREQUENCY DRIVE
AFF	ABOVE FINISHED FLOOR
AFG	ABOVE FINISHED GRADE
AHJ	AUTHORITY HAVING JURISTICTION
AIC	SYMM. AMPS INTERRUPTING CAP.
AL	ALUMINUM, ALARM LIGHT
AS	AMMETER SENSOR OR SWITCH
ASB	ALARM SILENCE BUTTON
ASYM	ASYMMETRICAL
AT	CB AMPERE TRIP SETTING
ATS	AUTOMATIC TRANSFER SWITCH
AUX	AUXILIARY
AWG	AMERICAN WIRE GAUGE
BC	BARE COPPER
BCG	BATTERY CHARGER
BSDG	BUILDING
C	CONDUIT, CONTACTOR
CB	CIRCUIT BREAKER
CCB	CONTROL CIRCUIT BREAKER
CDB	CONC ENCASED DUCT BANK
CGD	COMBUSTIBLE GAS DETECTOR
CKT	CIRCUIT
CMS	COMBINATION MOTOR STARTER
CNTL	CONTROL
C.O.	CONDUIT ONLY
CONC	CONCRETE
CPT	CONTROL POWER TRANSFORMER
CR	CONTROL RELAY
CT	CURRENT TRANSFORMER
DC	DIRECT CURRENT
DEF	DIESEL EXHAUST FLUID
DPDT	DOUBLE POLE DOUBLE THROW
EC	EMPTY CONDUIT
ECB	EMERGENCY CIRCUIT BREAKER
ECDB	EX CONC ENCASED DUCT BANK
ECP	EQUIPMENT CONTROL PANEL
EF	EXHAUST FAN
EG	EMERGENCY GENERATOR
EMH	ELECT MANHOLE (SEE MAS)
EMT	ELECTRICAL METAL TUBING
ENCL	ENCLOSURE
EPB	EXISTING PULLBOX
EQUIP	EQUIPMENT
ESB	EMERGENCY STOP BUTTON
ETM	ELAPSED TIME METER
EX	EXISTING
FB	FUSE BLOCK
FDR	FEEDER
F,FU	FUSE
FI	FLOW INDICATOR
FL	LAMP FLASHER
FLA	FULL LOAD AMPS
FLEX	FLEXIBLE CONDUIT
FLR	FLOOR
FLUOR	FLUORESCENT
FM	FLOW METER
FMC	FLEXIBLE METAL CONDUIT
F.O.	FAIL OPEN
FOC	FIBER OPTIC CABLE
FS	FLOW SWITCH
FT	FLOW TRANSMITTER
FUT	FUTURE
FVNR	FULL VOLTAGE NON-REVERSING
G	GREEN, GROUND
GALV	GALVANIZED
GDR	GROUNDING RESISTOR
GEC	GROUNDING ELECTRODE CONDUCTOR
GEN	GENERATOR
GFCI	GROUND FAULT CIRCUITINTERRUPTER
GFR	GROUND FAULT RELAY
GND	GROUND
GRS	GALVANIZED RIGID STEEL (CONDUIT)
GTB	GENERATOR TIE BREAKER

ABBREVIATIONS

ABBR.	DESCRIPTION
HH	HANDHOLE
HID	HIGH INTENSITY DISCHARGE
HOA	HAND/OFF/AUTO
HOR	HAND/OFF/REMOTE
HP	HORSEPOWER
HPS	HIGH PRESSURE SODIUM
HTR	HEATER
HV	HIGH VOLTAGE
HVAC	HEAT, VENTILATE, AIR COND.
HZ	HERTZ (FREQUENCY)
IC	INTERRUPTING CAPACITY
ID	INSIDE DIAMETER
IMC	INTERMEDIATE METAL CONDUIT
INST	INSTANTANEOUS
I/O	INPUT / OUTPUT SIGNALS
IP	INSTRUMENT PANEL
ISR	INTRINSIC SAFE RELAY
JB	JUNCTION BOX
K	KEY OR KIRK KEY INTERLOCK
kcmil	1000 CIRCULAR MILS
kV	KILOVOLTS
kVA	KILOVOLT-AMPERE
kVAR	KILOVOLT-AMPERE REACTIVE
kW	KILOWATT
kWh	KILOWATT-HOUR
LA	LIGHTING ARRESTER
LC	LOAD CENTER
LCP	LOCAL CONTROL PANEL
LFMC	LIQUID TIGHT FLEX METAL CONDUIT
LP-#	LIGHTING PANEL NUMBER #
LR	LOCAL/REMOTE OR LATCHING RELAY
LRA	LOCKED ROTOR AMPS
LS	LIMIT SWITCH
LT	LEVEL TRANSDUCER
LTC	LIGHTING CONTACTOR
LTG	LIGHTING
LV	LOW VOLTAGE
M	MOTOR OR MOTOR CONTACTOR
MAS	MAINTENANCE ACCESS STRUCTURE
MA	MILLIAMPS
MAX	MAXIMUM
MBS	MANUAL BYPASS SWITCH
MC	METAL CLAD
MCA	MAXIMUM CIRCUIT AMPS
MCB	MAIN CIRCUIT BREAKER
MCC	MOTOR CONTROL CENTER
MDP	MAIN DISTRIBUTION PANEL
MERC	MERCURY VAPOR
MFG	MANUFACTURER
MFR	MULTI-FUNCTIONAL RELAY
MGB	MAIN GROUNDING BUS
MLO	MAIN LUGS ONLY
MOCP	MAXIMUM OVERCURRENT PROTECTION
MOV	MOTOR OPERATED VALVE
MPZ	MINI-POWER ZONE
MS	MOTOR STARTER
MSC	MFR SUPPLIED CABLE
MTS	MANUAL TRANSFER SWITCH
MT	MOUNT
MTD	MOTOR TEMPERATURE DETECTOR
MV	MEDIUM VOLTAGE
N	NEUTRAL
NA	NOT APPLICABLE
NC	NORMALLY CLOSED
NEMA	NATIONAL ELEC. MFR. ASSOC.
NF	NON-FUSED
NIC	NOT IN CONTRACT
NO	NORMALLY OPEN
NP	NAMEPLATE
NTS	NOT TO SCALE
OC	OCCUPANCY CONTROL
OD	OUTSIDE DIAMETER
OL	OVERLOAD
OH	OVERHEAD
OWS	OPERATOR WORK STATION

ABBREVIATIONS

ABBR.	DESCRIPTION
P	POLE
PB	PULL BOX OR PUSH BUTTON
PC	PHOTOCELL
PCP	PROCESS CONTROL PANEL
PF	POWER FACTOR
PH	PHASE
PL	PILOT LIGHT
PLC	PROGRAMMABLE LOGIC CONTROLLER
PM	PHASE MONITOR
PMU	POWER MONITOR UNIT
PNL	PANEL
PP	POWER PANEL (480VAC)
PR	PAIR
PS	PRESSURE SWITCH
PT	POTENTIAL TRANSFORMER
PVC	POLYVINYL CHLORIDE CONDUIT
PWR	POWER
RCPT	RECEPTACLE
REF	REFERENCE
REQD	REQUIRED
RGS	RIGID GALVANIZED STEEL CONDUIT
RM	ROOM
RMC	RIGID METAL CONDUIT
RMS	ROOT MEAN SQUARE
RS	RIGID STEEL
RTD	RESISTANCE TEMPERATURE DETECTOR
RTU	REMOTE TELEMETRY UNIT
SA	SURGE ARRESTER
SC	SURGE CAPACITOR
SEC	SECONDARY
SEL	SELECTOR
SF	SUPPLY FAN
SH	SPACE HEATER
SLD	SINGLE LINE DIAGRAM
SMH	SIGNAL MAINTENANCE HOLE
S/N	SOLID NEUTRAL
SPEC	SPECIFICATIONS
SPD	SURGE PROTECTIVE DEVICE
SSRVS	SOLID STATE REDUCED VOLTAGE ST.
SST	STAINLESS STEEL
SUB	SUBSTATION
SV	SOLENOID VALVE
SW	SWITCH
SWBD	SWITCHBOARD
SWGR	SWITCHGEAR
SYM	SYMMETRICAL
SYS	SYSTEM
T	THERMOSTAT
TB	TERMINAL BLOCK
TDR	TIME DELAY RELAY
TEL	TELEPHONE
TEMP	TEMPERATURE
TJB	TERMINAL JUNCTION BOX
TS	THERMAL SWITCH
TSP	TWISTED SHIELDED PAIR
TVSS	TRANSIENT VOLTAGE SURGE SUPPR.
TYP	TYPICAL
UGE	UNDERGROUND ELECTRIC UTILITY
U/G	UNDERGROUND
UPS	UNINTERRUPTIBLE POWER SUPPLY
UVR	UNDERVOLTAGE RELAY
V	VOLT OR VOLTMETER
VA	VOLTAMPERE
VAR	VOLTAMPERE REACTIVE
VFD	VARIABLE FREQUENCY DRIVE
VS	VOLTMETER SWITCH
W	WATT
WHD	WATTHOUR DEMAND METER
WP	WEATHER PROOF
WW	WIREWAY
XFMR	TRANSFORMER
XMTR	TRANSMITTER
XP	EXPLOSION PROOF
Z	IMPEDANCE

ELECTRICAL PLAN/LAYOUT

SYMBOL	DESCRIPTION
	TERMINAL JUNCTION BOX
	ELECTRICAL EQUIPMENT
X	CEILING MOUNTED DOWNLIGHT LUMINAIRE - SEE SCHEDULE FOR TYPE
X	FLUORESCENT LUMINAIRE, SURFACE OR LAY IN TYPE SEE SCHEDULE FOR TYPE
X	LUMINAIRE AND POLE - SEE SCHEDULE FOR TYPE
X	WALL MOUNTED LUMINAIRE - SEE SCHEDULE FOR TYPE
	GROUND ROD - 5/8" x 20' COPPER CLAD UNLESS OTHERWISE NOTED
	GROUND ROD IN TEST WELL - 5/8" x 20' COPPER CLAD UNLESS OTHERWISE NOTED
X	EXIT LIGHTS - SOLID SECTION IS DIRECTION OF FACE SEE SCHEDULE FOR TYPE
X	EMERGENCY LIGHT WITH BATTERY PACK SEE SCHEDULE FOR TYPE
#	LIGHTING FIXTURE POWER AND SWITCHING LEGEND X = FIXTURE TYPE # = CIRCUIT NUMBER
[B2] / LPA-2	CONDUIT/CONDUCTOR - REFER TO CIRCUIT SCHEDULE HOME RUN - PANEL AND CIRCUIT NUMBER SHOWN
	EXPOSED CONDUIT AND CONDUCTORS*
	UNDERGROUND CONDUIT AND CONDUCTORS*
YCX	YARD CONDUIT. REFER TO YARD CONDUIT SCHEDULE
DB	DIRECT BURIED CONDUIT
CDB	CONCRETE ENCASED DUCT BANK
	CONDUIT, STUBBED AND CAPPED AS SHOWN
	GROUND WIRE, 4/0 CU UNLESS OTHERWISE NOTED
X / $ / #	WALL SWITCH: 2- DOUBLE POLE; 3- THREE WAY; 4- FOUR WAY; WP- WEATHERPROOF; P- PILOT LIGHT; K- KEY OPERATED; D- DIMMER; CRE- CORROSION RESISTANT # - CIRCUIT NO.
X / #	20A DUPLEX RECEPTACLE UNLESS SPECIFIED OTHERWISE WP - WEATHERPROOF; C - CLOCK HANGER; TL - TWIST LOCK; CRE - CORROSION RESISTANT; GFCI - GROUND FAULT INTERRUPTER; FTC - FULL TIME COVER
	20A QUADRAPLEX RECEPTACLE - UNLESS SPECIFIED OTHERWISE
	20A DUPLEX RECEPTACLE - UNLESS SPECIFIED OTHERWISE. LOCATED ABOVE COUNTER TOP
	20A DUPLEX RECEPTACLE - UNLESS SPECIFIED OTHERWISE. MOUNTED FLUSH IN FLOOR.
30	RECEPTACLE, SPECIAL PURPOSE - AMPERAGE AS INDICATED.
	TELEPHONE/DATA RECEPTACLE (OUTLET BOX, 18" AFF) W - WALL MOUNTED, 54" AFF
	TELEPHONE/DATA RECEPTACLE MOUNTED FLUSH IN FLOOR
J	JUNCTION BOX NEMA 12 ENCLOSURE UNLESS INDICATED OTHERWISE. 4X = NEMA 4X SS
F	FIRE ALARM PULL STATION
F	FIRE ALARM HORN/STROBE LIGHT
F	FIRE ALARM STROBE LIGHT
W	ELEVATOR WARNING LIGHT
S SD H HD	FIRE ALARM SMOKE OR HEAT DETECTOR
SD D	DUCT SMOKE DETECTOR
FACP	FIRE ALARM CONTROL PANEL
FAAP	FIRE ALARM ANNUNCIATOR PANEL
	CONDUIT CHASE
WH	WATER HEATER

ONE LINE DIAGRAMS, RISER DIAGRAMS AND SCHEMATICS

SYMBOL	DESCRIPTION
E	ELECTRICAL INTERLOCK
400 AT 600 AF	DRAWOUT CIRCUIT BREAKER, LOW VOLTAGE 600= FRAME RATING, 400=TRIP SETTING
400 AT 600 AF	DRAWOUT CIRCUIT BREAKER, MEDIUM VOLTAGE 600= FRAME RATING, 400=TRIP SETTING
600 / 400	DRAWOUT FUSED SWITCH, LOW OR MEDIUM VOLTAGE 600= FRAME RATING, 400=FUSE RATING
(3)	CURRENT TRANSFORMER, NUMBER OF WINDINGS INDICATED
XFMR DRY kVA 3P/4W 480-120/208V	TRANSFORMER, VOLTAGES, PHASE AND RATING INDICATED AS APPLICABLE
	LIGHTNING ARRESTER
	CAPACITOR OR SURGE CAPACITOR
X 0-600V	METER SCALE RANGE SHOWN IF REQUIRED PM – PHASE MONITOR; A – AMPS; P – POWER METER; V – VOLTS
	FUSE
TVSS	TRANSIENT VOLTAGE SURGE SUPPRESSION
	GROUND
CPT 480V 120V	CONTROL TRANSFORMER
GFR	GROUND FAULT RELAY WITH C.T.
	PUSH–BUTTON SWITCH, MOMENTARY CONTACT, NORMALLY OPEN
	PUSH–BUTTON SWITCH, MOMENTARY CONTACT, NORMALLY CLOSED
	PUSH BUTTON SWITCH, MAINTAINED CONTACTS WITH MECHANICAL INTERLOCK
	REMOTE DEVICE
A	**INDICATING LIGHT - LETTER INDICATES COLOR** **A - AMBER; G - GREEN; B - BLUE; R - RED; C - CLEAR; W - WHITE**
A	**PUSH TO TEST AND CONNECT INDICATING LIGHT SCHEMATIC DIAGRAMS ONLY** **A - AMBER; G - GREEN; B - BLUE; R - RED; C - CLEAR; W - WHITE**
5	MOTOR, SQUIRREL CAGE INDUCTION UNLESS OTHERWISE NOTED – HORSEPOWER INDICATED
	OVERLOAD RELAY HEATER
	MAGNETIC STARTER WITH NEMA SIZE INDICATED
M	MOTOR CIRCUIT PROTECTOR, MAGNETIC, 3 POLE UNLESS INDICATED OTHERWISE.
400	CIRCUIT BREAKER, THERMAL MAGNETIC TRIP SHOWN, 3 POLE UNLESS INDICATED OTHERWISE.
400 225	FUSED SWITCH, SWITCH AND FUSE CURRENT RATING INDICATED, 3 POLE UNLESS INDICATED OTHERWISE.
100	SWITCH – CURRENT RATING INDICATED, 3 POLE UNLESS INDICATED OTHERWISE.
60A 3P / 60A 3P	DISC SWITCH – FUSED, NON–FUSED
G or	GENERATOR

SYMBOL	DESCRIPTION
S M	MANUAL MOTOR STARTER SWITCH, NEMA 4X UNLESS OTHERWISE NOTED. NUMBER OF POLES AS REQUIRED.
PB 4X	PUSH–BUTTON STATION, NEMA 12 ENCLOSURE UNLESS INDICATED OTHERWISE. 4X = NEMA 4X STAINLESS STEEL ENCLOSURE. SEE CONTROL DIAGRAMS FOR TYPE PUSH BUTTON REQUIRED.
30 4X	NONFUSED DISCONNECT SWITCH, SIZE INDICATED, 3 POLE UNLESS INDICATED OTHERWISE, NEMA 12 ENCLOSURE, 4X = NEMA 4X STAINLESS STEEL
F 40 60 4X	FUSED DISCONNECT SWITCH, SIZE INDICATED (60 = SWITCH RATING: 40 = FUSE RATING) 3 POLE UNLESS INDICATED OTHERWISE, NEMA 12 ENCLOSURE, 4X = NEMA 4X STAINLESS STEEL
LC 30 12	LIGHTING CONTACTOR, CURRENT RATING INDICATED, NEMA 12 ENCLOSURE UNLESS INDICATED OTHERWISE. SEE CONTROL DIAGRAM FOR NUMBER OF POLES. 4X = NEMA 4X TYPE 316 STAINLESS STEEL
2 4X	MAGNETIC STARTER, NEMA SIZE INDICATED, NEMA 12 ENCLOSURE, UNLESS INDICATED OTHERWISE. SEE CONTROL DIAGRAM. 4X = NEMA 4X STAINLESS STEEL
2 4X	COMBINATION (FUSE OR CIRCUIT BREAKER AS INDICATED), MAGNETIC STARTER, NEMA SIZE INDICATED, NEMA 12 ENCLOSURE UNLESS INDICATED OTHERWISE. SEE CONTROL SCHEMATIC DIAGRAM. 4X = NEMA 4X STAINLESS STEEL
	ELECTRIC RESISTANCE HEATER
ETM	ELAPSED TIME METER
CRx	CONTACT – NORMALLY OPEN WITH COIL INDICATED
CRx	CONTACT – NORMALLY CLOSED WITH COIL INDICATED
CRx OR Rx LRx (L)	CONTROL RELAY, X = SEQUENTIAL NUMBER CONTROL RELAY, X=SEQUENTIAL NUMBER LATCHING RELAY, X=SEQUENTIAL NUMBER L – LATCH, U – UNLATCH
TDx NOTC	TIME DELAY RELAY, X=SEQUENTIAL NUMBER NOTC=NORMALLY OPEN TIMED CLOSED NOTO=NORMALLY OPEN TIMED OPEN AFTER CLOSE NCTO = NORMALLY CLOSED TIMED OPEN; NCTC = NORMALLY CLOSED TIMED CLOSED AFTER OPEN
	TEMPERATURE OPENS ON RISING TEMPERATURE, CLOSES ON FALLING TEMPERATURE
	CLOSES ON RISING TEMPERATURE, OPENS ON FALLING TEMPERATURE
H O A XOO OOX	SELECTOR SWITCH: MAINTAINED CONTACT WITH CONTACT POSITION INDICATED, CHART IDENTIFIES OPERATION

	POSITION		
CKT.	HAND	OFF	AUTO
1	X	O	O
2	O	O	X

X - CLOSED CONTACT
O - OPEN CONTACT

GENERAL

SYMBOL	DESCRIPTION
	CONNECTION POINT TO EQUIPMENT SPECIFIED, FURNISHED AND INSTALLED UNDER OTHER SECTIONS. RACEWAY, CONDUCTOR AND CONNECTION IN THIS SECTION.
1"C, 2#12, 1#12G **1"C, 1-25/C TYPE 1**	INDICATES RACEWAY AND CIRCUIT CONDUCTORS. FIRST NUMBER IS RACEWAY SIZE. THE FOLLOWING NUMBERS ARE THE CONDUCTOR QUANTITIES, SIZES, AND TYPES. NOTE: * ALL UNMARKED CONDUIT RUNS CONSIST OF 2#12, 1#12G IN 3/4"C.
	DEMOLITION TO BE REMOVED OR DELETED

THIS IS A STANDARD LEGEND SHEET. SOME SYMBOLS OR ABBREVIATIONS MAY APPEAR ON THIS SHEET AND NOT BE UTILIZED ON PROJECT.

REV	ISSUED FOR	DATE	BY

PROJECT ENGINEER: J. BOWDAN
DESIGNED BY: J. BROAD
DRAWN BY: J. BROAD
CHECKED BY: J. BURKE

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE (0, 1/2", 1")

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HAZEN AND SAWYER
4000 HOLLYWOOD BLVD SUITE 750N
HOLLYWOOD, FL 33021

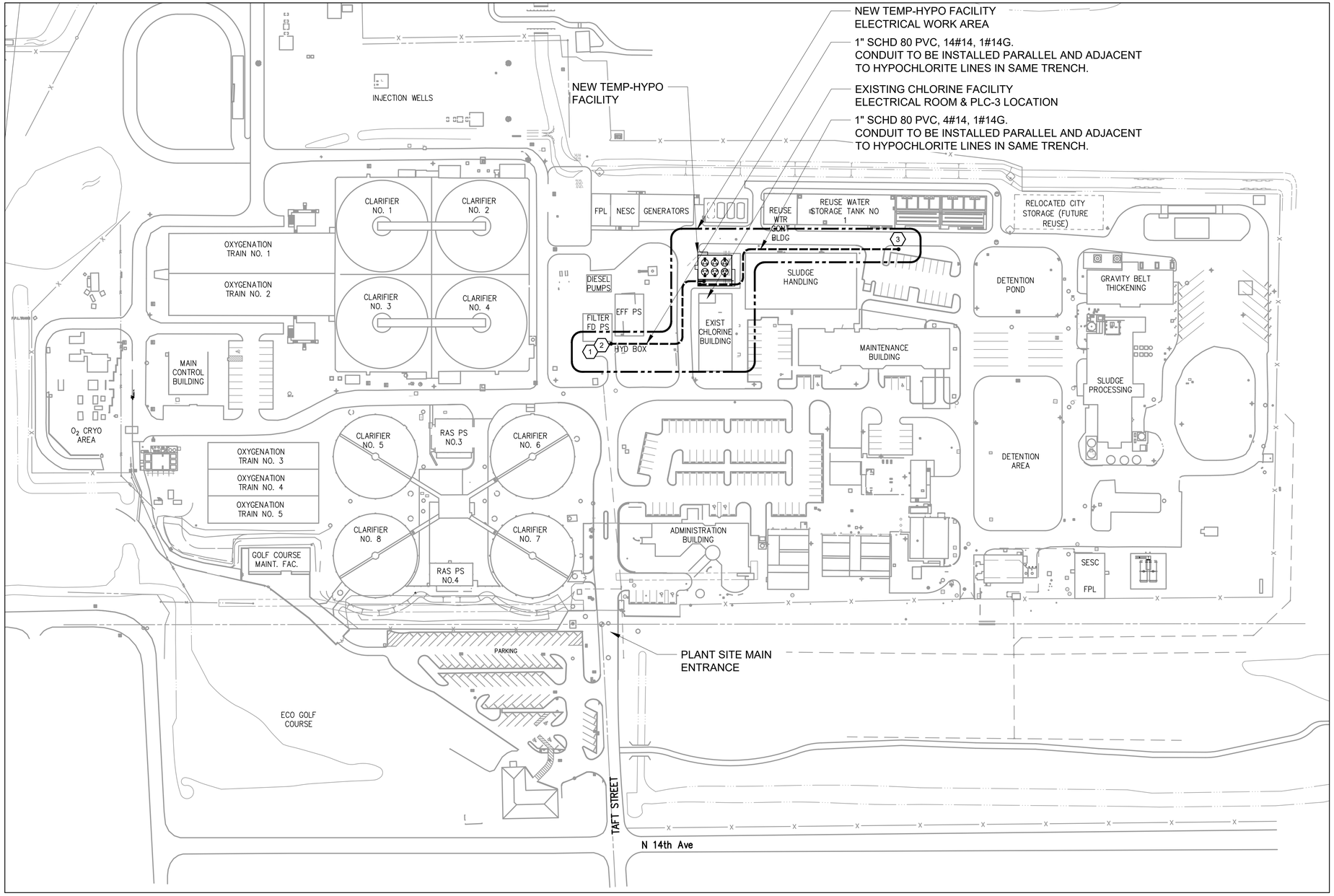
CITY OF HOLLYWOOD
HOLLYWOOD, FLORIDA

SODIUM HYPOCHLORITE
TEMPORARY STORAGE AND FEED SYSTEM

ELECTRICAL
LEGEND AND SYMBOLS

DATE: DECEMBER 2025
HAZEN NO.: 4321-111
CONTRACT NO.: 22-8073
DRAWING NUMBER: E-02

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KEYED NOTES:

1. LOCAL CONTROL STATION LCS-56015 FOR EFFLUENT PUMP STATION METERING PUMP SKID. COORDINATE NUMBER OF WIRES WITH ASSOCIATED CONTROL STRATEGY.
2. LEVEL SWITCH LSH-56015 AT OUTFALL DOSING STATION SUMP
3. LEVEL SWITCH LSH-56016 AT REUSE AND NPW CCT DOSING STATION SUMP

1"=80'-0"

80 40 0 80'

REV	ISSUED FOR	DATE	BY

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CHECKED BY:	J. BURKE

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4000 HOLLYWOOD BLVD SUITE 750N
HOLLYWOOD, FL 33021

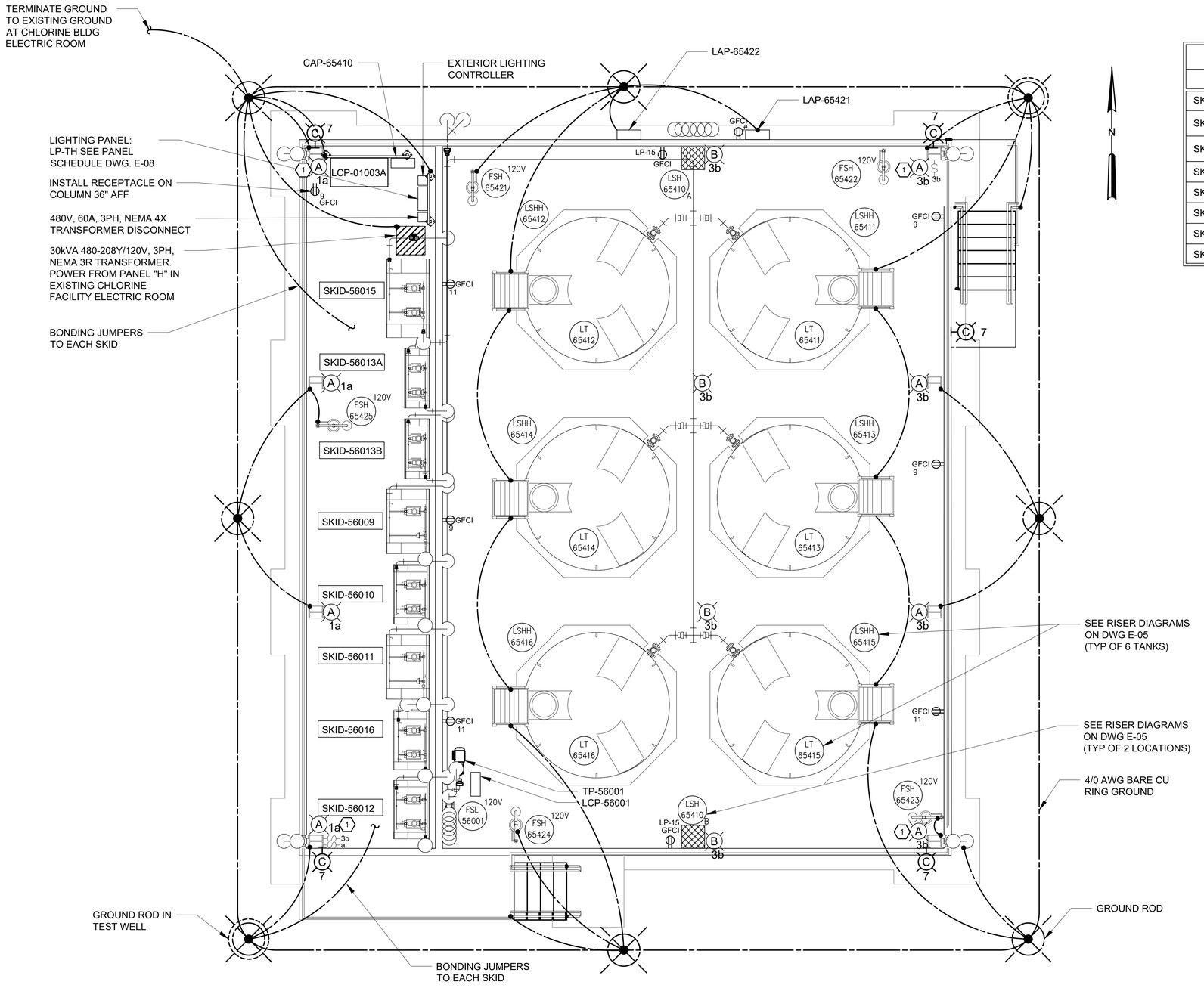
CITY OF HOLLYWOOD
HOLLYWOOD, FLORIDA

SODIUM HYPOCHLORITE
TEMPORARY STORAGE AND FEED SYSTEM

ELECTRICAL
SITE PLAN - OVERALL

DATE:	DECEMBER 2025
HAZEN NO.:	4321-111
CONTRACT NO.:	22-8073
DRAWING NUMBER:	E-03

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METERING PUMPS SKIDS			
SKID ID	ASSOCIATED LCP ID	METERING PUMPS ID	METERING PUMP SKID DESCRIPTION
SKID-56015	LCP-56015 & LCP-56615	MP-56015 & MP-56615	EFFLUENT PUMP STATION
SKID-56013A	LCP-56013A & LCP-56613A	MP-56013A & MP-56613A	REUSE SYSTEM PRE-CHLORINATION
SKID-56013B	LCP-56013B & LCP-56613B	MP-56013B & MP-56613B	NON-POT SYSTEM PRE-CHLORINATION
SKID-56009	LCP-56009	MP-56009	RAS PUMP STATION
SKID-56010	LCP-56010 & LCP-56610	MP-56010 & MP-56610	HEADWORKS ODOR CONTROL
SKID-56011	LCP-56611	MP-56611	INFLUENT PUMP STATION
SKID-56016	LCP-56016 & LCP-56616	MP-56016 & MP-56616	CHLORINE CONTACT BASINS - REUSE SYSTEMS
SKID-56012	LCP-56012 & LCP-56612	MP-56012 & MP-56612	CHLORINE CONTACT BASINS - NON-POT SYSTEM

NOTES:

1. ALL RECEPTACLES SHALL BE INSTALLED CENTERLINE 36" AFF.
2. ALL LIGHTING SWITCHES SHALL BE INSTALLED CENTERLINE48" AFF.
3. INSTRUMENTATION CONDUITS SHALL TERMINATE AT LCP-01003A
4. SEE POWER AND CONTROL RISER DIAGRAMS ON DWG. E-05.
5. POWER CONDUITS SHALL TERMINATE AT PANEL LP-"TH"
6. "A" TYPE LIGHTING FIXTURES SHALL BE PENDANT HUNG AT ELEVATION 31.0
7. "B" TYPE LIGHTING FIXTURES SHALL BE MOUNTED 9'-0" AFG.
8. TRANSFER PUMP AND METERING PUMPS SKIDS SHALL BE POWERED FROM PANEL LP-"TH" SEE PANEL SCHEDULES ON DRAWING E-09.
9. THE FOLLOWING SHALL BE BONDED TO THE RING GROUND SYSTEM:
   - 9.1. EACH PUMP SKID (DAISY CHAIN BETWEEN SKIDS)
   - 9.2. ALL EXPOSED METAL STRUCTURE
   - 9.3. ALL HANDRAILS
   - 9.4. EACH EYEWASH / SHOWERS
   - 9.5. SLAB REBAR MAT (MINIMUM OF TWO LOCATIONS AT OPPOSITE CORNERS)

KEYED NOTES:

1. THE FOUR TYPE "A" CORNER FIXTURES SHALL BE INSTALL AT A 45 DEGREE ANGLE POINTING INWARD TOWARDS THE CENTER OF THE TANKS AREA.

LEGEND:

A 3b
- FIXTURE SWITCH GROUP (a or b)
- PANEL "LP-TP CIRCUIT #
- FIXTURE TYPE

3a
- FIXTURE SWITCH GROUP (a, b, OR c)
- SWITCH TYPE, eg. 3 = 3 Way

1/4"=1'-0" (1 0 1 2 3 7')

REV	ISSUED FOR	DATE	BY

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DRAWN BY:	J. BROAD
CHECKED BY:	J. BURKE

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HAZEN AND SAWYER
4000 HOLLYWOOD BLVD SUITE 750N
HOLLYWOOD, FL 33021

CITY OF HOLLYWOOD
HOLLYWOOD, FLORIDA

SODIUM HYPOCHLORITE
TEMPORARY STORAGE AND FEED SYSTEM

ELECTRICAL
TEMPORARY HYPOCHLORITE SYSTEM
POWER AND LIGHTING PLAN

DATE:	DECEMBER 2025
HAZEN NO.:	4321-111
CONTRACT NO.:	22-8073
DRAWING NUMBER:	E-04

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EXISTING GE A SERIES PANELBOARD CHL–"H" IN
EXISTING CHLORINATION FACILITY ELECTRIC ROOM
CAT: AEF3422MBX
MAIN: 225A, 480Y/277, 3–PH, 4–WIRE

NEW 3P–50A

EXISTING CHLORINATION FACILITY

NEW TEMPORARY CHLORINATION FACILITY

3#6, 1#10G, 1"C

60A
3P

NEMA 4X 316 SS

30 kVA XFMR
480–208Y/120V
3P/4W
NEMA 3R DRY TRANS

3#1, 1#8G, 2"C

PANEL LP: TH
208Y/120V, 3PH, 4W
SEE SCHEDULE ON DWG E–08

3P–125A

1P–20A | 1P–20A | 1P–20A | 1P–20A | 1P–20A | 1P–20A

3#12, 1#12G, 3/4"C
2#12, 1#12G, 3/4"C
2#12, 1#12G, 3/4"C
2#12, 1#12G, 3/4"C
3#12, 1#12G, 3/4"C
2#12, 1#12G, 3/4"C

PANEL LP: TH 208Y/120V, 3PH
CONT. ON DWG. E–06

LCP-01003A (PLC-3A)
TEMPORARY HYPO-FACILITY -
MAIN CONTROL PANEL

LCP-01003A (PLC-3A)
CONT. ON DWG E-06

4#16 TSP, 1"C
8#14, 1#14G, 3/4"C

LAP–65422
WEST HYPO TANKS UNLOADING
PANEL

1#16 TSP, 3/4"C

LT 65412 — TK-65412
LT 65414 — TK-65414
LT 65416 — TK-65416

WEST HYPO BULK STORAGE TANKS

4#16 TSP, 1"C
8#14, 1#14G, 3/4"C

LAP–65421
EAST HYPO TANKS UNLOADING
PANEL

1#16 TSP, 3/4"C

LT 65411 — TK-65411
LT 65413 — TK-65413
LT 65415 — TK-65415

EAST HYPO BULK STORAGE TANKS

4#14, 1#14G, 3/4"C

CAP–65410
CONTAINMENT
ALARM PANEL

2#14, 1#14G, 3/4"C
2#14, 1#14G, 3/4"C

LSH 65410 A
LSH 65410 B

CONTAINMENT
FLOOD

14#14, 1#14G, 3/4"C

LCP–56001 HYPO
TRANSFER PUMP
PANEL SEE
I–DWGS

2#14, 1#14G, 1"C
3#12, 1#12G, 3/4"C
120V
FSL 56001
M

TP-56001
HYPO TRANSFER
PUMP (2 HP)

10#14, 1#14G, 3/4"C

FSH 65421 | FSH 65422 | FSH 65423 | FSH 65424 | FSH 65425

EYEWASH SHOWERS
ALARMS

2#14, 1#14G, 3/4"C

LSH 56016

REMOTE DOSING
LOCATION No.1
CHLORINATION AT
FILTER CCTs (8 & 9)

2#14, 1#14G, 3/4"C

LSH 56015

REMOTE DOSING
LOCATION No.2
OUTFALL PUMP
STATION (7A)

REV	ISSUED FOR	DATE	BY

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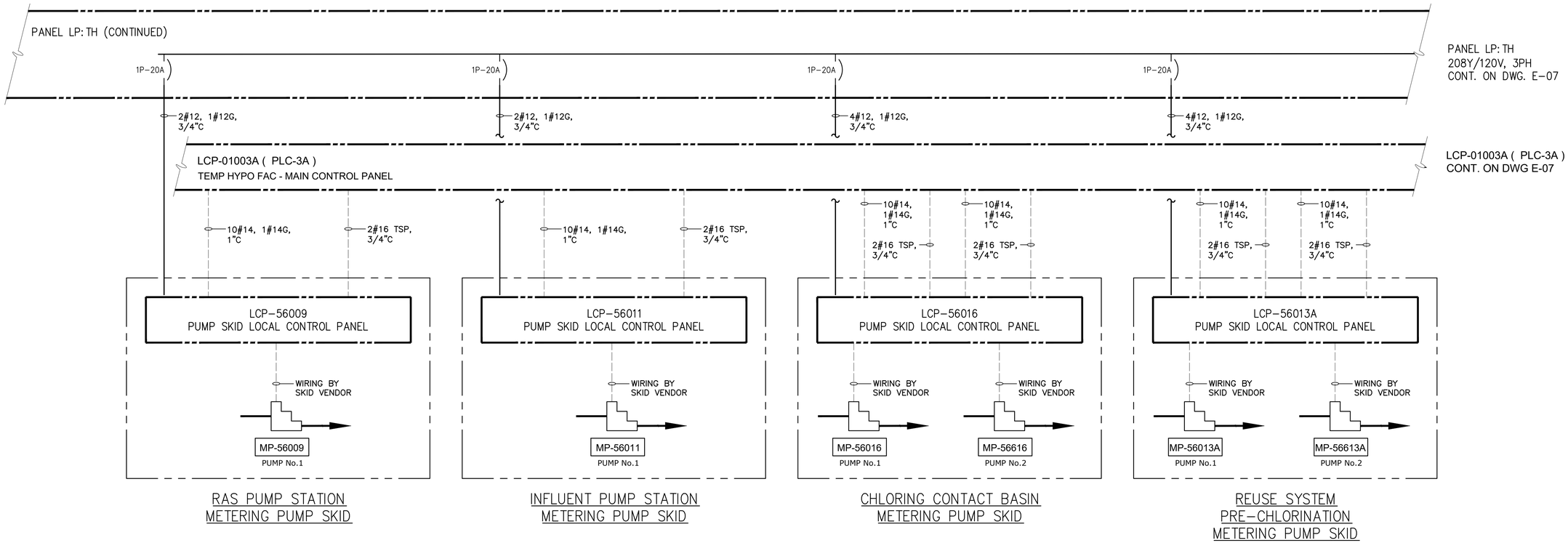
CITY OF HOLLYWOOD
HOLLYWOOD, FLORIDA

SODIUM HYPOCHLORITE
TEMPORARY STORAGE AND FEED SYSTEM

ELECTRICAL
POWER AND CONTROL RISER DIAGRAM
SHEET 1

DATE:	DECEMBER 2025
HAZEN NO.:	4321-111
CONTRACT NO.:	22-8073
DRAWING NUMBER:	E-05

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RAS PUMP STATION
METERING PUMP SKID

INFLUENT PUMP STATION
METERING PUMP SKID

CHLORING CONTACT BASIN
METERING PUMP SKID

REUSE SYSTEM
PRE-CHLORINATION
METERING PUMP SKID

REV	ISSUED FOR	DATE	BY

PROJECT ENGINEER:	J. BOWDAN
DESIGNED BY:	J. BROAD
DRAWN BY:	J. BROAD
CHECKED BY:	J. BURKE

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4000 HOLLYWOOD BLVD SUITE 750N
HOLLYWOOD, FL 33021

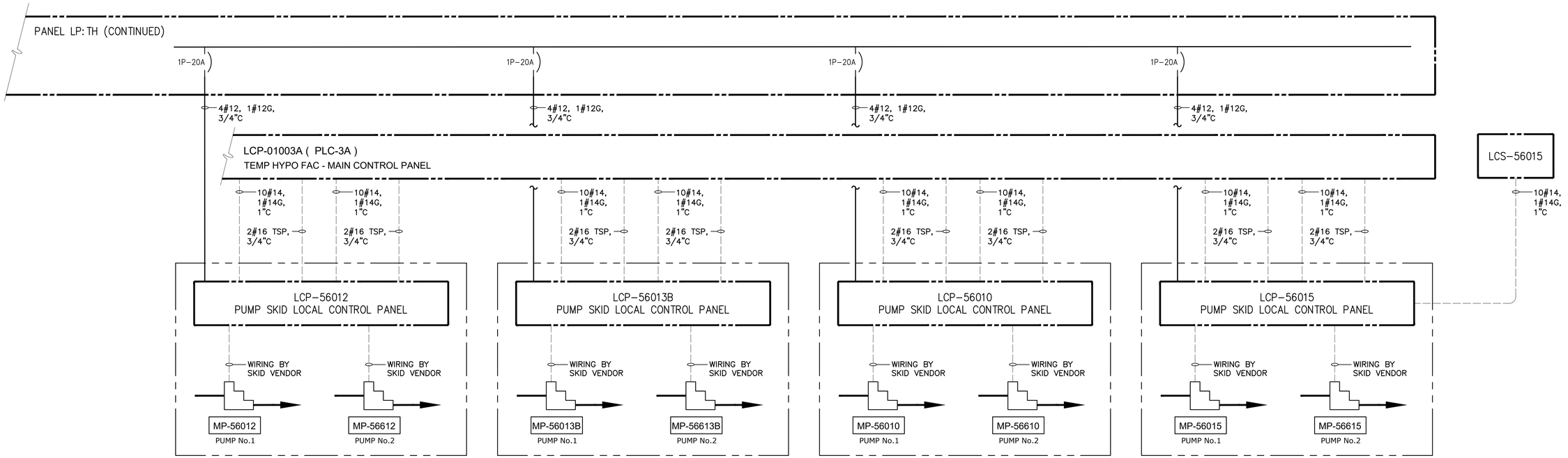
CITY OF HOLLYWOOD
HOLLYWOOD, FLORIDA

SODIUM HYPOCHLORITE
TEMPORARY STORAGE AND FEED SYSTEM

ELECTRICAL
POWER AND CONTROL RISER DIAGRAM
SHEET 2

DATE:	DECEMBER 2025
HAZEN NO.:	4321-111
CONTRACT NO.:	22-8073
DRAWING NUMBER:	E-06

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CHLORING CONTACT BASIN
NON-POT SYSTEM
METERING PUMP SKID

NON-POT SYSTEM
PRE-CHLORINATION
METERING PUMP SKID

HEADWORKS
ODOR CONTROL SYSTEM
METERING PUMP SKID

EFFLUENT PUMP STATION
METERING PUMP SKID

REV	ISSUED FOR	DATE	BY

PROJECT ENGINEER:	J. BOWDAN
DESIGNED BY:	J. BROAD
DRAWN BY:	J. BROAD
CHECKED BY:	J. BURKE

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4000 HOLLYWOOD BLVD SUITE 750N
HOLLYWOOD, FL 33021

CITY OF HOLLYWOOD
HOLLYWOOD, FLORIDA

SODIUM HYPOCHLORITE
TEMPORARY STORAGE AND FEED SYSTEM

ELECTRICAL
POWER AND CONTROL RISER DIAGRAM
SHEET 3

DATE:	DECEMBER 2025
HAZEN NO.:	4321-111
CONTRACT NO.:	22-8073
DRAWING NUMBER:	E-07

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LOCATION: TEMP HYPO FACILITY (TH)					PROPOSED PANEL "LP: TH"						BUS:125A MAIN BKR	
VOLTS: 208Y/120V, 3PH, 4W, 10kAIC FED FROM EXISTING CHLORINE BLDG.					REMARKS: PANEL SHALL INCLUDE INTERNAL INTEGRAL SPD NEMA 4X 316 STAINLESS STEEL						MOUNTING: RACK	
		BUS kVA LOAD							BUS kVA LOAD				
CKT	DESCRIPTION	A	B	C	WIRE/CONDUIT	C.B.	C.B.	WIRE/CONDUIT	A	B	C	DESCRIPTION	CKT
1	TEMP HYPO FAC LIGHTING	1.0			2#12, 1#12G 3/4"C	1P-20	3P-20	3#12, 1#12G 3/4"C	3.0				2
3	TEMP HYPO FAC LIGHTING		1.0		2#12, 1#12G 3/4"C	1P-20				3.0		TRANSFER PUMP: TP-56001	4
5	EXTERIOR LIGHTING CONTROL			0.1	2#12, 1#12G 3/4"C	1P-20					3.0		6
7	HYPO FAC EXTERNAL LIGHTING	1.0			2#12, 1#12G 3/4"C	1P-20	1P-20	2#12, 1#12G 3/4"C	1.0			MP-56011	8
9	TEMP HYPO FAC RECPTS		0.7		2#12, 1#12G 3/4"C	1P-20	1P-20	2#12, 1#12G 3/4"C		1.0		MP-56009	10
11	TEMP HYPO FAC RECPTS			0.7	2#12, 1#12G 3/4"C	1P-20	1P-20	2#12, 1#12G 3/4"C			1.0	MP-56015 & MP-56615	12
13	STATION ALARM STROBE	0.1			2#12, 1#12G 3/4"C	1P-20	1P-20	2#12, 1#12G 3/4"C	1.0			MP-56013A & MP-56613A	14
15	SUMP PUMP		2.0		2#12, 1#12G 3/4"C	1P-20	1P-20	2#12, 1#12G 3/4"C		1.0		MP-56016 & MP-56616	16
17	LCP-01003A			0.2	2#12, 1#12G 3/4"C	1P-20	1P-20	2#12, 1#12G 3/4"C			1.0	MP-56013B & MP-56613B	18
19	LCP-01003A	0.2			2#12, 1#12G 3/4"C	1P-20	1P-20	2#12, 1#12G 3/4"C	1.0			MP-56012 & MP-56612	20
21	LAP-65421		0.4		2#12, 1#12G 3/4"C	1P-20	1P-20	2#12, 1#12G 3/4"C		1.0		MP-56010 & MP-56610	22
23	LAP-65422			0.4	2#12, 1#12G 3/4"C	1P-20	1P-20				0.4	SPARE	24
25	CAP-65410	0.4			2#12, 1#12G 3/4"C	1P-20	1P-20		0.4			SPARE	26
27	EYEWASH SHOWERS		0.1		2#12, 1#12G 3/4"C	1P-20	1P-20			0.4		SPARE	28
29	SPARE			0.4		1P-20	1P-20				0.4	SPARE	30
31	SPARE	0.4				1P-20	1P-20		0.4			SPARE	32
33	SPARE		0.4			1P-20	1P-20			0.4		SPARE	34
35	SPARE			0.4		1P-20	1P-20				0.4	SPARE	36
37	SPACE											SPACE	38
39	SPACE											SPACE	40
41	SPACE											SPACE	42
		3.1	4.6	2.2					6.8	6.8	6.1		
								TOTAL kVA/PH	10	11	8		
								TOTAL AMPS/PH	82	95	69		

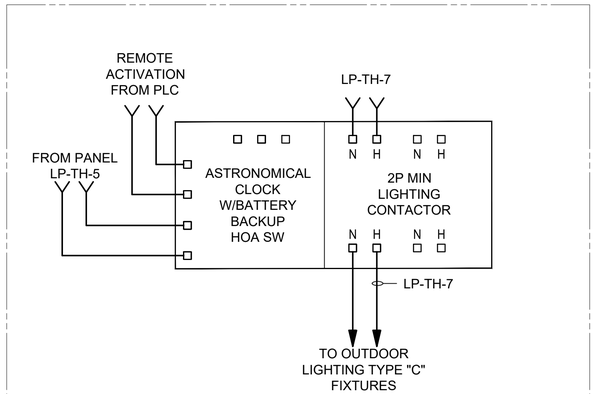
LOCAL CONTROL PANEL SCHEDULE

ITEM #	PANEL ID	SKID / LCP DESCRIPTION	ENCLOSURE RATING
1	LCP-01003A	TEMP HYPO FAC - MAIN CONTROL PANEL	NEMA 4X, 316 SS
2	LAP-65421	EAST HYPO UNLOADING ALARM PANEL	NEMA 4X, 316 SS
3	LAP-65422	WEST HYPO UNLOADING ALARM PANEL	NEMA 4X, 316 SS
4	CAP-65410	TEMP HYPO FAC - CONTAINMENT ALARM PANEL	NEMA 4X, 316 SS
5	LCP-56001	TRANSFER PUMP LCP	NEMA 4X, 316 SS
6	LCP-56016 & LCP-56616	CHLORINE CONTACT BASINS - REUSE SYSTEM	NEMA 4X, 316 SS BY SKID VENDOR
7	LCP-56013A & LCP-56613A	REUSE SYSTEM PRE-CHLORINATION	NEMA 4X, 316 SS BY SKID VENDOR
8	LCP-56012 & LCP-56612	CHLORINE CONTACT BASINS NON-POT SYSTEM	NEMA 4X, 316 SS BY SKID VENDOR
9	LCP-56013B & LCP-56613B	NON-POT SYSTEM PRE-CHLORINATION	NEMA 4X, 316 SS BY SKID VENDOR
10	LCP-56010 & LCP-56610	HEADWORKS - ODOR CONTROL SYSTEM	NEMA 4X, 316 SS BY SKID VENDOR
11	LCP-56015 & LCP-56615	EFFLUENT PUMP STATION	NEMA 4X, 316 SS BY SKID VENDOR
12	LCP-56009	RAS PUMP STATION	NEMA 4X, 316 SS BY SKID VENDOR
13	LCP-56011	INFLUENT PUMP STATION	NEMA 4X, 316 SS BY SKID VENDOR
14	LCS-56015	EFFLUENT PUMP STATION REMOTE LOCAL CONTROL STATION	NEMA 4X, 316 SS

LIGHTING FIXTURE SCHEDULE

REF. ID	~QTY	FIXTURE TYPE	LAMP	VOLTAGE	WATTS	MOUNTING	CATALOG DESCRIPTION
A	8	TEMP HYPO FACILITY WALL PACK LED FIXTURES VAPOR TIGHT WET AREA	INTEGRAL LED UNIT	120–277V	~100	MOUNT TO SURFACE OF VERTICAL I–BEAMS SUPPORTS AT 18'–0" AFF AND CENTER LINE OF FIXTURE	ACUITY BRANDS INC: MODEL: PHG 12000LM HEF MALR 50K 90CRI STAINLESS STEEL FASTENERS
B	4	TEMP HYPO FACILITY HIGH BAY LED FIXTURES VAPOR TIGHT WET AREA	INTEGRAL LED UNIT	120–277V	~100	MOUNT TO BOTTOM OF HORIZ CROSS I–BEAM MEMBERS. APPROXIMATELY CENTERED BETWEEN TWO ROWS OF TANKS. VERIFY WITH ENGINEER FOR FINAL LOCATIONS.	ACUITY BRANDS INC: MODEL: PHG 12000LM HEF MALR 50K 90CRI STAINLESS STEEL FASTENERS
C	5	OUTDOOR LED WALL PACK FIXTURE FOR WALL WASH AND AREA LIGHTING. CONTROL VIA ASTRONOMICAL TIME CLOCK.	INTEGRAL LED UNIT	120V	39	FIXTURE BOTTOM SHALL BE APPROXIMATELY 18'–0" ABOVE ASSOCIATED FINISHED GRADE IF POSSIBLE ELSE AS HIGH AS PRACTICABLE. CONFIRM WITH ENGINEER OR OWNER.	ACUITY BRANDS INC. MODEL: TWH LED 10C 1000 40K T3M MVOLT DDBXD.

LIGHTING FIXTURES NOTES:
1. ALL MOUNTING AND INSTALLATION HARDWARE FOR FIXTURES AND POLES SHALL BE STAINLESS STEEL
2. QUANTITIES LISTED IN TABLE ARE APPROXIMATE.
3. ALL FIXTURE CATALOG NUMBERS ARE "OR EQUAL".



LIGHTING CONTROLLER (LC)

REV	ISSUED FOR	DATE	BY

PROJECT ENGINEER: J. BOWDAN
DESIGNED BY: J. BROAD
DRAWN BY: J. BROAD
CHECKED BY: J. BURKE
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE 0 1/2" 1"

Hazen
HAZEN AND SAWYER
4000 HOLLYWOOD BLVD SUITE 750N
HOLLYWOOD, FL 33021

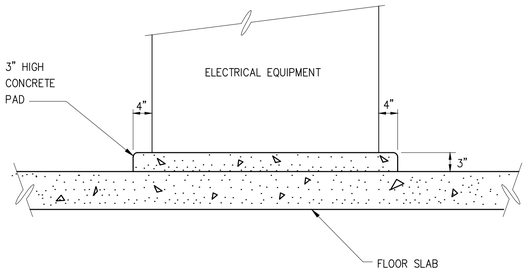
CITY OF HOLLYWOOD
HOLLYWOOD, FLORIDA

SODIUM HYPOCHLORITE
TEMPORARY STORAGE AND FEED SYSTEM

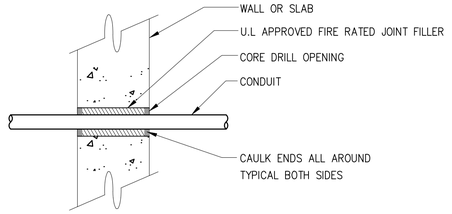
ELECTRICAL
SCHEDULES

DATE: DECEMBER 2025
HAZEN NO.: 4321-111
CONTRACT NO.: 22-8073
DRAWING NUMBER: E-08

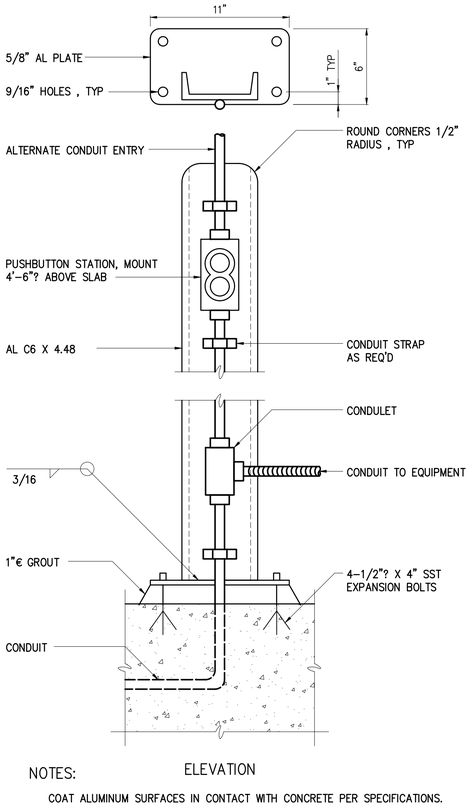
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PLOT DATE: 8/14/2025 2:12 PM BY: JBROAD



EQUIPMENT HOUSE KEEPING PAD
1600010



CONDUIT PENETRATION AT WALL OR SLAB
1611112



ELEVATION

NOTES:

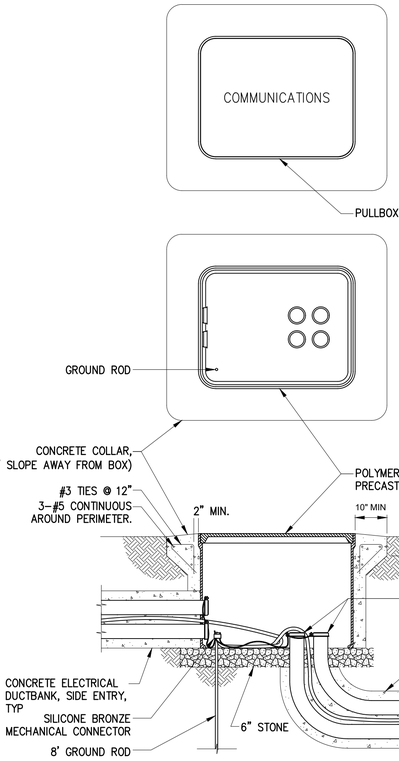
COAT ALUMINUM SURFACES IN CONTACT WITH CONCRETE PER SPECIFICATIONS.

1 SUPPLY 1'-2" DIAMETER X 2'-6" DEEP FOUNDATION WHERE MOUNTING SURFACE IS NOT AVAILABLE.

2 USE SST WASHERS, NUTS AND BOLTS FOR MOUNTING DEVICES.

3 TYPICAL PUSHBUTTON STATION INSTALLATION DETAIL

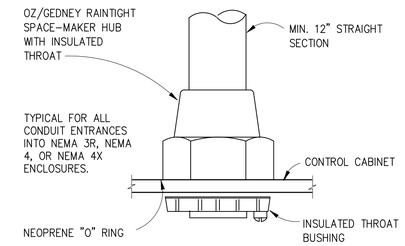
E-26-0401



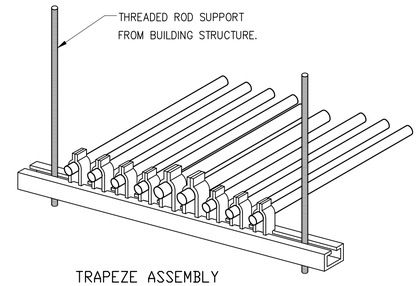
NOTE:
1. FOR SIDE ENTRY, CONDUIT DUCTBANK SHALL ENTER PULLBOX AT LOWEST POINT.
2. GROUNG CONDUCTORS WITHIN DUCTBANK SHALL BE BOLTED TOGETHER AND TO GROUND ROD.
3. GROUNDING CONDUCTORS FROM GROUNDING BUSHING SHALL BE BOLTED TO GROUND ROD.

POLYMER CONCRETE COMMUNICATIONS PULLBOX DETAIL

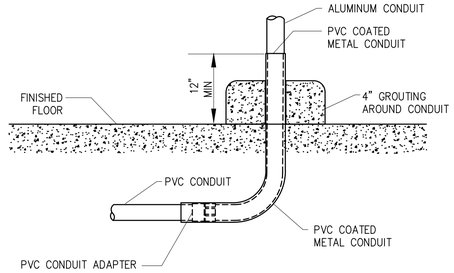
E-33-0103



CONDUIT HUB
1611110

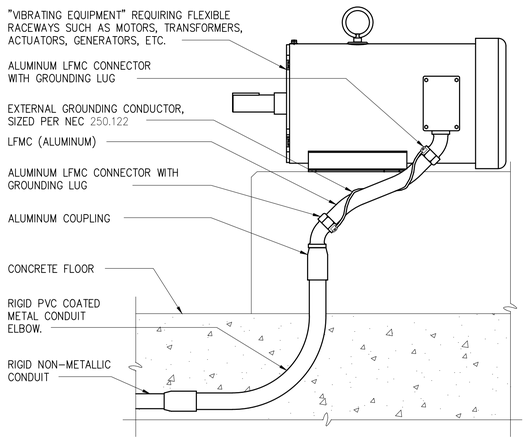


TRAPEZE ASSEMBLY
1611107



CONDUIT FLOOR ENTRANCE GROUT DETAIL

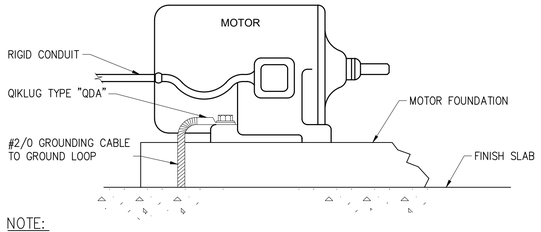
E-26-0102



WHERE NON-METALLIC CONDUIT TRANSITIONS TO RIGID METALLIC CONDUIT AND / OR LIQUIDTIGHT METALLIC CONDUIT, (LFMC), TO FEED VIBRATING TYPE LOADS, THE CONTRACTOR SHALL FURNISH AND INSTALL AN EXTERNAL BARE COPPER GROUNDING CONDUCTOR AND APPROVED GROUNDING LFMC CONNECTORS TO ENSURE GROUND CONTINUITY TO THE RIGID METALLIC CONDUIT AS SHOWN. THE GROUNDING CONDUCTOR SHALL BE SIZED ACCORDING TO NEC 250.122 AND BE NEATLY WRAPPED AROUND LFMC AS SHOWN. LFMC INSTALLED IN THIS MANNER SHALL NOT BE USED FOR A CONTINUOUS GROUND PATH PER NEC 350.60.

LFMC CONDUIT GROUND STRAP DETAIL

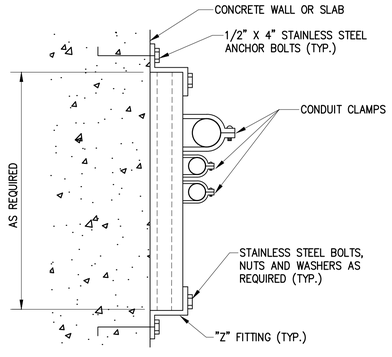
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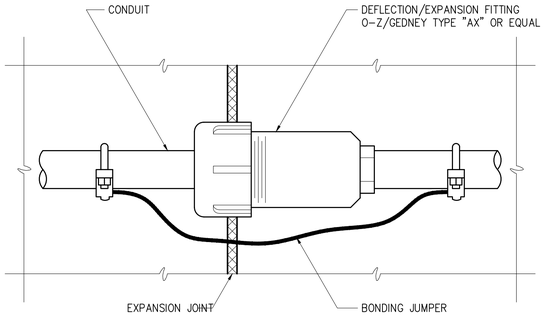
NOTE:
THIS GROUND IS IN ADDITION TO THE GROUND FROM THE MAIN ELECTRICAL SERVICE.

MOTORS AND EQUIPMENT GROUNDING

E-26-0104A



CONDUIT SUPPORT
1611114



CONDUIT DEFLECTION/EXPANSION FITTING FOR EXPOSED CONDUIT
1611105

REV	ISSUED FOR	DATE	BY

PROJECT ENGINEER:	J. BOWDAN
DESIGNED BY:	J. BROAD
DRAWN BY:	J. BROAD
CHECKED BY:	J. BURKE

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE (0 1/2" 1")

Hazen
HAZEN AND SAWYER
4000 HOLLYWOOD BLVD SUITE 750N
HOLLYWOOD, FL 33021

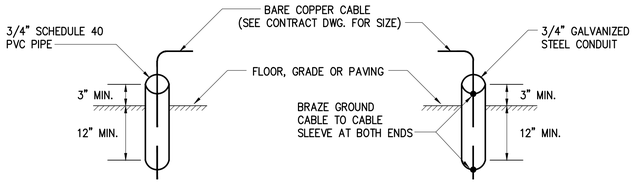
CITY OF HOLLYWOOD
HOLLYWOOD, FLORIDA

SODIUM HYPOCHLORITE
TEMPORARY STORAGE AND FEED SYSTEM

ELECTRICAL
TYPICAL DETAILS SHEET 1

DATE:	DECEMBER 2025
HAZEN NO.:	4321-111
CONTRACT NO.:	22-8073
DRAWING NUMBER:	E-09

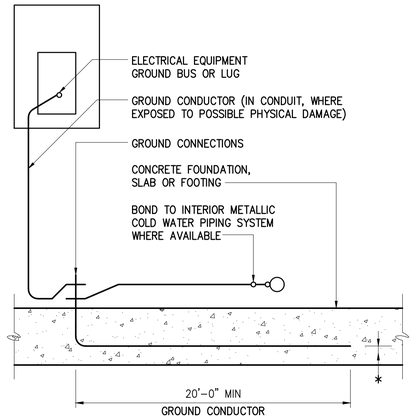
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PLOT DATE: 8/14/2025 2:12 PM BY: JBROAD



PREFERRED SLEEVE INSTALLATION ALTERNATIVE SLEEVE INSTALLATION

GROUND CABLE SLEEVE INSTALLATION

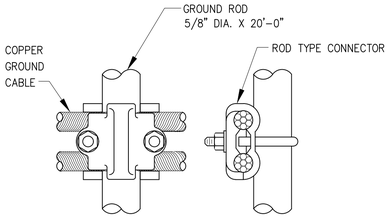
1617001



* 1" CLEAR FOR ELEVATED SLABS
3" CLEAR FOR SLABS ON GRADE
OR FOOTING

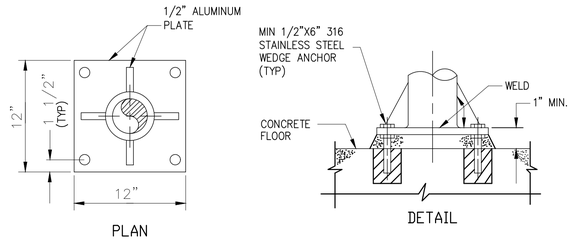
CONCRETE ENCASED GROUND

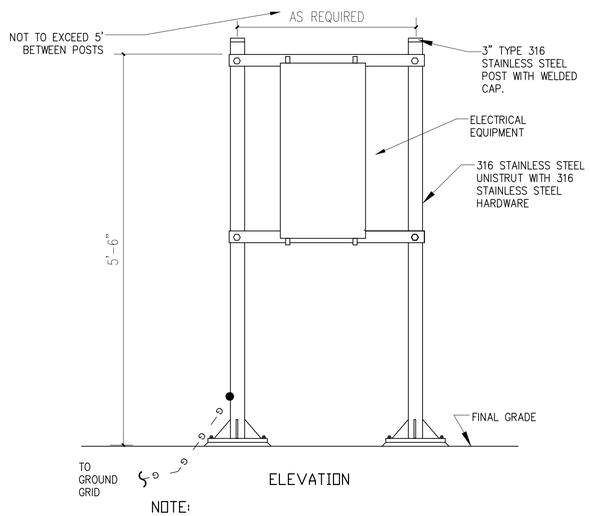
1617004



CABLE TO ROD CONNECTION

1617011



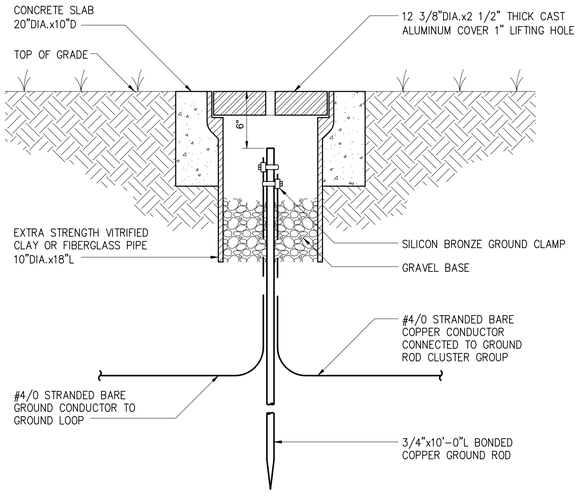


NOTE:

ADJUST THE NUMBER OF SUPPORT POSTS TO ACCOMMODATE THE EQUIPMENT TO BE INSTALLED.

TYPICAL EQUIPMENT RACK ON GRADE

1613010

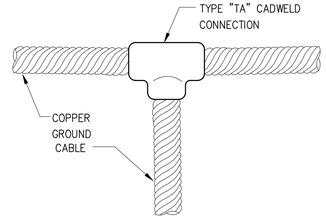


NOTES:

1 REFER TO JOB SPECIFICATION FOR MINIMUM SYSTEM RESISTANCE TO GROUND. IF THIS RESISTANCE CANNOT BE MET WITH SINGLE 10'-0" RODS, ADD ADDITIONAL SECTIONS TO RODS OR ADD NEW RODS AS REQUIRED, SPACED 6'-0" TO 10'-0" FROM EXISTING RODS.

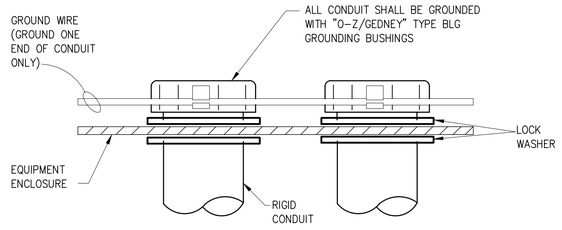
ELECTRICAL INSTALLATION DETAIL
GROUND ROD/GROUND LOOP TEST POINT

E-26-0501



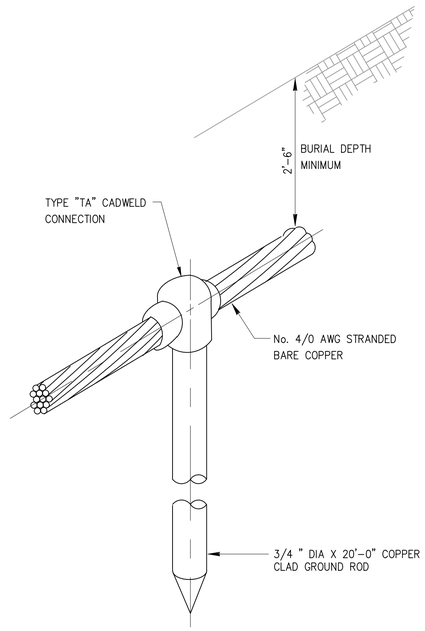
GROUND CABLE CONNECTION

1617013



CONDUIT GROUNDING

1617014



GROUND ROD DETAIL

1617012

REV	ISSUED FOR	DATE	BY

PROJECT ENGINEER:	J. BOWDAN
DESIGNED BY:	J. BROAD
DRAWN BY:	J. BROAD
CHECKED BY:	J. BURKE

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE 0 1/2" 1"

Hazen
HAZEN AND SAWYER
4000 HOLLYWOOD BLVD SUITE 750N
HOLLYWOOD, FL 33021

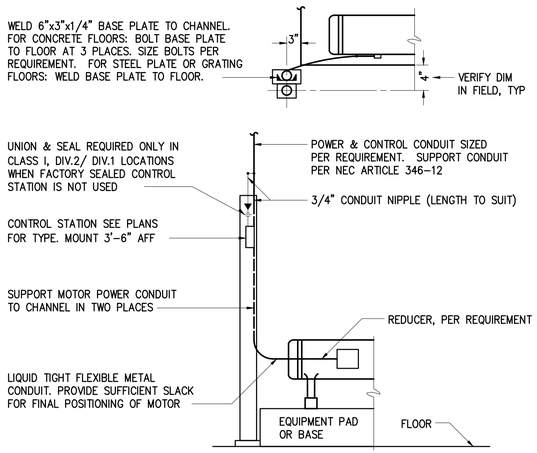
CITY OF HOLLYWOOD
HOLLYWOOD, FLORIDA

SODIUM HYPOCHLORITE
TEMPORARY STORAGE AND FEED SYSTEM

ELECTRICAL
TYPICAL DETAILS SHEET 2

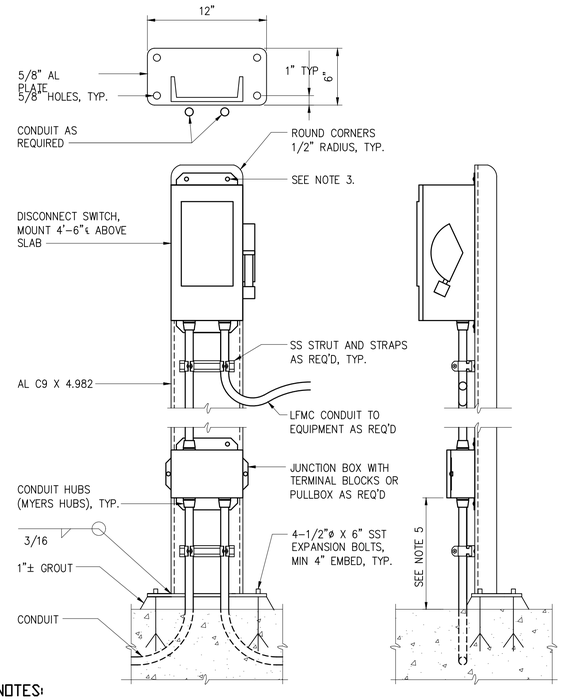
DATE:	DECEMBER 2025
HAZEN NO.:	4321-111
CONTRACT NO.:	22-8073
DRAWING NUMBER:	E-10

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PLOT DATE: 8/14/2025 2:12 PM BY: JBROAD



MOTOR CONDUIT INSTALLATION DETAIL
HAZARDOUS AND NONHAZARDOUS LOCATIONS
POWER AND CONTROL WIRE IN SAME CONDUIT

1618001

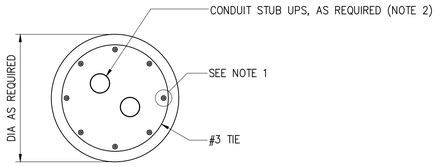


NOTES:

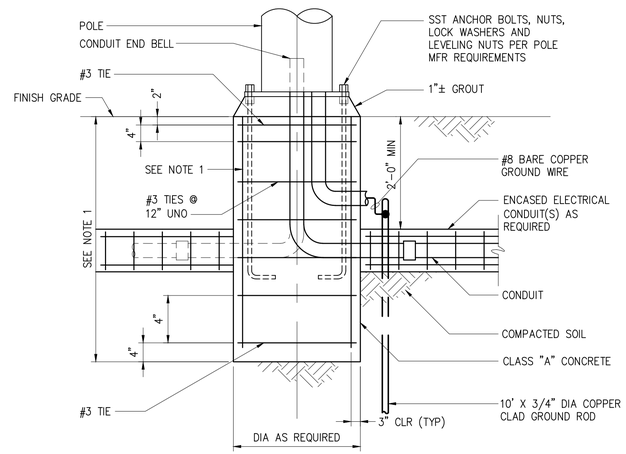
1. COAT ALUMINUM SURFACES IN CONTACT WITH CONCRETE PER SPECIFICATIONS.
2. SUPPLY 1'-2" DIAMETER X 2'-6" DEEP FOUNDATION WHERE MOUNTING SURFACE IS NOT AVAILABLE.
3. USE SST WASHERS, LOCKWASHERS, NUTS AND BOLTS FOR MOUNTING EQUIPMENT AND STRUT SUPPORTS TO CHANNEL. DRILL EQUIPMENT MOUNTING TABS AS NECESSARY TO COORDINATE WITH CHANNEL WIDTH.
4. REFERENCE STANDARD DETAIL 1611102 WHERE CONDUIT EMERGES FROM CONCRETE.
5. COORDINATE MOUNTING HEIGHT ABOVE CONCRETE WITH CLASSIFICATION REQUIREMENTS.

TYPICAL 30/60/100 AMP DISCONNECT SWITCH INSTALLATION DETAIL

E-26-0403



PLAN



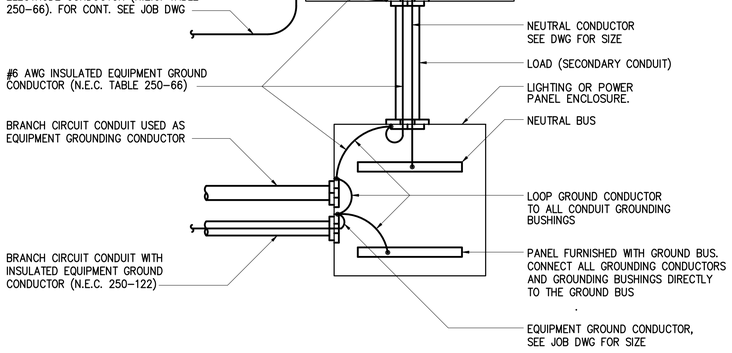
ELEVATION

NOTES:

1. DEPTH AND REINFORCEMENT SHALL BE DETERMINED BY POLE MANUFACTURER IN ACCORDANCE WITH SECTION 16500. LOADING SHALL BE IN ACCORDANCE WITH SECTION 16500.
2. CONTRACTOR SHALL CAREFULLY COORDINATE LOCATION AND QUANTITY OF CONDUITS IN THE BASE SO THAT WHEN POLE IS INSTALLED, IT WILL FIT OVER THE CONDUITS.

CAST-IN-PLACE POLE-MOUNTED AREA LIGHTING FIXTURE BASE (FLUSH BASE)

E-26-0601

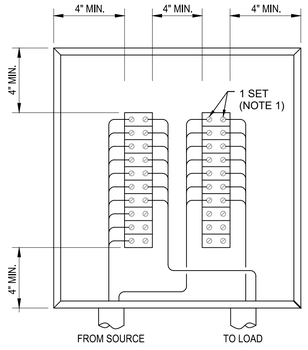


NOTES:

1 GROUNDING CONDUCTORS SHOWN ARE FOR TRANSFORMERS UP TO 45KVA. SEE ELECT. JOB DRAWINGS FOR LARGER TRANSFORMERS OR WHEN VOLTAGE DROP REQUIRES LARGER CONDUCTORS.

LOW VOLTAGE TRANSFORMER GROUNDING INSTALLATION DETAIL

1618003



TERMINAL JUNCTION BOX

1613015

NOTES:

1. PROVIDE ONE SET OF TERMINALS FOR EACH CONDUCTOR INCOMING FROM THE SOURCE OR LOAD (WHICHEVER IS GREATER).
2. TERMINATE ALL INCOMING WIRES. PROVIDE MIN. 25% SPARE TERMINALS. QTY OF SPARES SHALL BE DETERMINED BY USING QTY OF WIRES INCOMING FROM THE SOURCE OR LOAD, WHICHEVER IS GREATER. INDIVIDUAL DRAIN WIRES SHALL BE INCLUDED IN THIS CALCULATION.
3. PROVIDE ADDITIONAL TERMINALS AS REQUIRED FOR TERMINATING DRAIN WIRE ON SHIELDED CABLES. DO NOT BOND INDIVIDUAL SHIELDS WITH ENCLOSURE OR WITH OTHER SHIELDS. SHIELDS SHALL BE GROUNDED ONLY AT THE SOURCE OR LOAD, AS SPECIFIED.
4. ALL TERMINAL JUNCTION BOX INSTALLATIONS SHALL BE IN ACCORDANCE WITH THIS DETAIL.

REV	ISSUED FOR	DATE	BY

PROJECT ENGINEER:	J. BOWDAN
DESIGNED BY:	J. BROAD
DRAWN BY:	J. BROAD
CHECKED BY:	J. BURKE

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE (0, 1/2", 1")

Hazen
HAZEN AND SAWYER
4000 HOLLYWOOD BLVD SUITE 750N
HOLLYWOOD, FL 33021

CITY OF HOLLYWOOD
HOLLYWOOD, FLORIDA

SODIUM HYPOCHLORITE
TEMPORARY STORAGE AND FEED SYSTEM

ELECTRICAL
TYPICAL DETAILS SHEET 3

DATE:	DECEMBER 2025
HAZEN NO.:	4321-111
CONTRACT NO.:	22-8073
DRAWING NUMBER:	E-11

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PLOT DATE: 8\14\2025 2:12 PM BY: JBROAD

CITY OF HOLLYWOOD

FLORIDA

SOUTHERN REGIONAL WASTEWATER TREATMENT PLANT

CONTRACT DOCUMENTS

TEMPORARY HYPOCHLORITE SYSTEM

CITY PROJECT NO. 24-9122

BID SET

ATTACHMENT D – TECHNICAL SPECIFICATIONS

DECEMBER 2025

Hazen

Hazen and Sawyer
4000 Hollywood Boulevard, Suite 750N
Hollywood, FL 33021
Certificate of Authorization Number: 2771

Engineers Project No. 4321-111

CITY PROJECT NO. 24-9122

SOUTHERN REGIONAL WASTEWATER TREATMENT PLANT

CONTRACT DOCUMENTS

TEMPORARY HYPOCHLORITE SYSTEM

CITY PROJECT NO. 24-9122

BID SET

DECEMBER 2025

Professional Engineer Certifications

J. PHILIP COOKE, PE

License No. 47137
Divisions General,Civil, Mechanical

EVAN P. CURTIS, PE

License No. 69657
Divisions Instrumentation

JEAN P. SILVA, PE

License No. 66522
Divisions Structural

JOHN BURKE, PE

License No. 17301
Divisions Electrical

SECTION VI – ATTACHMENT D

TECHNICAL SPECIFICATIONS

TABLE OF CONTENTS

DIVISION 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS

Refer to City of Hollywood, South Regional Wastewater Treatment Plant, Temporary Sodium Hypochlorite System, City Project No. 24-9122, Bidding Documents Sections I through V.

DIVISION 01 – GENERAL REQUIREMENTS

Section	Title
01 11 00	Summary of Work
01 14 00	Coordination with Owner's Operations
01 20 00	Measurement and Payment
01 25 00	Substitution Procedures
01 26 00	Contract Modification Procedures
01 29 73	Schedule of Values
01 29 76	Progress Payment Procedures
01 31 19	Project Meetings
01 32 00	Construction Progress Schedule
01 33 00	Submittal Procedures
01 35 20	Confined Space Entry Plan
01 40 00	Quality Control and Testing Services
01 42 00	References
01 45 33	Special Inspections
01 51 00	Temporary Utilities
01 52 00	Construction Facilities
01 55 00	Contractor Access and Parking
01 57 00	Temporary Controls
01 65 00	Product Delivery Requirements
01 66 00	Product Storage and Protection Requirements

Section	Title
01 71 23	Field Engineering
01 71 33	Protection of Work and Property
01 73 00	Demolition and Execution of Work
01 73 23	Anchorage and Bracing of Nonstructural Components
01 74 00	Cleaning and Waste Management
01 75 00	Checkout and Startup Procedures
01 77 19	Closeout Requirements
01 78 23	Operation and Maintenance Data
01 78 39	Project Record Documents
01 78 43	Spare Parts and Extra Material
01 79 00	Instruction of Owner's Personnel

DIVISION 02 – EXISTING CONDITIONS

Section	Title
02 32 00	Subsurface Exploration
02 41 00	Site Demolition
02 41 13	Pavement Removal and Replacement
02 60 00	Contaminated Soil

DIVISION 03 – CONCRETE

Section	Title
03 11 00	Concrete Formwork
03 15 00	Concrete Accessories
03 15 16	Joints in Concrete
03 21 00	Reinforcing Steel
03 30 00	Cast-in-Place Concrete
03 35 00	Concrete Finishes
03 39 00	Concrete Curing
03 40 00	Precast Concrete

03 48 00	Precast Concrete Specialties
03 60 00	Grout

DIVISION 04 – MASONRY (NOT USED)

DIVISION 05 – METALS

Section	Title
05 05 13	Galvanizing
05 05 23	Metal Fastening
05 10 00	Metal Materials
05 12 00	Structural Steel
05 13 00	Stainless Steel
05 50 00	Metal Fabrications
05 51 00	Metal Stairs
05 51 33	Ladders
05 52 00	Guards and Railings
05 53 00	Gratings, Checkered Floor Plates, and Access Doors
05 55 00	Stair Treads and Nosings
05 56 00	Castings
05 59 00	Bearing Devices and Anchoring

DIVISION 06 – WOOD, PLASTICS, AND COMPOSITES

Section	Title
06 51 00	Glass Fiber and Resin Fabrications

DIVISION 07 – THERMAL AND MOISTURE PROTECTION (NOT USED)

Section	Title
07 90 00	Joint Fillers, Sealants, and Caulking

DIVISION 08 – OPENINGS (NOT USED)

DIVISION 09 – FINISHES

Section	Title
09 90 00	Painting

DIVISION 10 – SPECIALTIES

Section	Title
10 14 00	Identifying Devices
10 43 10	Chemical Handling Safety Equipment
10 73 16	Canopies

DIVISION 12 – FURNISHINGS (NOT USED)

DIVISION 13 – SPECIAL CONSTRUCTION

Section	Title
13 34 19	Metal Buildings

DIVISION 21 – FIRE SUPPRESSION (NOT USED)

DIVISION 22 – PLUMBING

Section	Title
22 15 00	Domestic Water Piping, Specialties, and Eyewash Showers

DIVISION 23 – HEATING, VENTILATING, AND AIR CONDITIONING (NOT USED)

DIVISION 26 – ELECTRICAL

Section	Title
26 05 00	Basic Electrical Requirements
26 05 19	Low-Voltage Conductors and Cables
26 05 26	Grounding and Bonding for Electrical Systems

Section	Title
26 05 29	Hangers and Supports for Electrical Systems
26 05 33.13	Conduit for Electrical Systems
26 05 33.16	Boxes for Electrical Systems
26 05 53	Identification for Electrical Systems
26 05 60	Low-Voltage Electric Motors
26 09 16	Electric Controls and Relays
26 22 00	Low-Voltage Transformers
26 24 16	Panelboards
26 27 26	Wiring Devices
26 29 13.13	Low-Voltage Enclosed Motor Controllers – Full Voltage
26 43 13	Surge Protective Devices
26 50 00	Lighting

DIVISION 27 – COMMUNICATIONS (NOT USED)

DIVISION 28 – ELECTRONIC SAFETY AND SECURITY (NOT USED)

DIVISION 31 – EARTHWORK

Section	Title
31 12 00	Site Preparation
31 23 13	Subgrade Preparation
31 23 16	Excavation
31 23 19	Dewatering
31 23 23	Fill and Backfill
31 23 24	Flowable Fill
31 23 33	Trenching and Backfilling
31 25 00	Erosion and Sedimentation Controls

DIVISION 32 – EXTERIOR IMPROVEMENTS

Section	Title
32 11 00	Surface Restoration
32 12 00	Asphalt Concrete Pavement
32 15 00	Limerock Base
32 16 00	Concrete Curb and Sidewalk
32 17 23	Pavement Markings
32 92 23	Sodding

DIVISION 33 – UTILITIES (NOT USED)

DIVISION 35 – WATERWAY AND MARINE CONSTRUCTION (NOT USED)

DIVISION 40 – PROCESS INTERCONNECTIONS

Section	Title
40 05 00	Basic Mechanical Requirements
40 05 07	Pipe Supports
40 05 19	Ductile Iron Pipe
40 05 31	PVC/CPVC Pipe
40 05 51	Valves, General
40 05 57	Valve Operators
40 05 61	Gate Valves
40 05 65.23	Check Valves
40 05 68.13	PVC and CPVC Valves
40 05 68.23	Miscellaneous Valves
40 05 78	Air Valves for Water and Wastewater Service
40 05 97	Piping and Equipment Identification Systems
40 06 20	Process Pipe and Valve Schedules
40 61 13	Process Control System General Provisions
40 61 15	Process Control System Submittals

Section	Title
40 61 21	Process Control System Testing
40 61 21.71	Factory Witness Test
40 61 21.72	Field Testing
40 61 21.73	Final Acceptance Test
40 61 22	Tools, Supplies, and Spare Parts, General
40 61 23	Signal Coordination Requirements
40 61 24	Quality Assurance
40 61 26	Process Control System Training
40 61 90	Schedules and Control Descriptions, General
40 61 91	Process Control System Instrument List
40 61 93	Process Control System Input/Output List
40 61 96	Process Control Descriptions
40 62 00	Computer System Hardware and Ancillaries
40 63 43	Programmable Logic Controllers
40 66 00	Network and Communication Equipment
40 67 00	Control System Equipment Panels and Racks
40 67 63	Uninterruptible Power Systems
40 68 00.13	Process Control Software (Modify)
40 70 00	Instrumentation for Process Systems
40 71 39	Paddle Wheel Insertion Flow Meters
40 71 79.16	Flow Switches (Thermal)
40 72 23.01	Radar Level Meter – Two Wire
40 72 73	Sight Level Gauges
40 72 76.26	Level Switches (Sliding Type)
40 73 13	Pressure and Differential Pressure Gauges
40 78 00	Panel Mounted Instruments
40 78 56	Isolators, Intrinsically-Safe Barriers, and Surge Suppressors
40 78 59	Power Supplies

Section	Title
40 79 00	Miscellaneous Instruments, Valves, and Fittings

DIVISION 41 – MATERIAL PROCESSING AND HANDLING EQUIPMENT (NOT USED)

DIVISION 43 – PROCESS GAS AND LIQUID HANDLING, PURIFICATION, AND STORAGE EQUIPMENT

Section	Title
43 41 43	Polyethylene Storage Tanks

DIVISION 44 – POLLUTION AND WASTE CONTROL MANAGEMENT (NOT USED)

DIVISION 46 – WATER AND WASTEWATER EQUIPMENT

Section	Title
46 00 00	Equipment General Provisions
46 33 42	Mechanical Diaphragm Metering Pump
46 33 43	Solenoid Diaphragm metering Pump
46 33 67.1	Magnetically Coupled Centrifugal Thermoplastic Pumps
46 41 42	Chemical Injection Assemblies

APPENDIX A – GEOTECHNICAL REPORT

DIVISION 01 – GENERAL REQUIREMENTS

SECTION 01 11 00
SUMMARY OF WORK

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes:

1. Summary
2. Location and Description of Work
3. Construction Contracts, This Project
4. Construction Contracts, Other Projects
5. Work by Others
6. Work by Owner
7. Owner Furnished Equipment and Materials
8. Owner Assigned Procurement Contracts
9. Sequence and Progress of Work
10. Contractor's Use of Site
11. Easements and Rights-of-Way
12. Notices to Owners and Authorities of Properties Adjacent to the Work
13. Salvage of Equipment and Materials
14. Partial Utilization by Owner

1.02 LOCATION AND DESCRIPTION OF WORK

A. The Work is located at the following Site:

1. The Southern Regional Wastewater Treatment Plant (SRWWTP), specifically located on the parking lot immediately east of the existing Chlorine Building. Address: 1621 N 14th Ave, Hollywood, FL 33020

11-18-20

B. The Work to be performed under this Contract includes, but is not limited to, constructing the Work described below and all appurtenances related to the Work as described below.

1. New Temporary Sodium Hypochlorite System:

a. Constructed new above ground concrete structure with raised containment curbing, foundation system, access stairs, handrail, and metal canopy system that will support and house new sodium hypochlorite equipment.

b. Furnish and install eight (8) packaged metering pump skids complete with piping, valves, simplex or duplex control panel, and related appurtenances pre-installed on each skid.

c. Furnish and install one (1) transfer pump and associated starter panel, valves, and piping to bulk storage tanks.

d. Furnish and install six (6) 6,650-gallon, dual-walled bulk sodium hypochlorite storage tanks complete with ladders, safety climb system, nozzles and related appurtenances.

e. Furnish and install associated piping, valves, pipe hangers, and supports between tanks, metering pumps, and dosing locations.

f. Furnish and install new electrical gear, panels, conduit, wiring, interior and exterior lighting, outlets, switches and related appurtenances.

g. Furnish and install new instrumentation and controls including PLC-based control panel, tank fill and level monitoring panels, sump high level panel, field devices, and related appurtenances

h. Furnish and install new double containment piping above and below ground from the metering pumps at the New Temporary Sodium Hypochlorite structure to dosing locations.

i. Furnish and install new tapping sleeves, valves, and pipelines from existing NPW loop to new Sodium Hypochlorite Dosing Stations

j. Furnish and install two (2) new Sodium Hypochlorite Dosing Stations complete with concrete containment pads, panel backboard, motive water piping, injection system, valves, and related appurtenances:

1) One (1) located near parking lot adjacent to and west of the existing Reuse and Non-Potable Chlorine Contact Tanks.

2) One (1) located on west wall of the Filter Feed Pump Station adjacent to and north of the Hydraulic Structure.

k. Perform miscellaneous abandonment in place, removals, and/or relocations of existing plant piping where shown on the drawings.

l. Perform pavement demolition and removals. Install new pavement, curbing, and sidewalk where shown on the Drawings and as needed to accommodate the Work and to repair paving and site work damaged by Contractor's operations.

1.03 CONSTRUCTION CONTRACTS, THIS PROJECT

A. The term "Contract Documents" refers to the entire set of Bid Proposal, Agreement, General Conditions, Supplementary Conditions, Technical Specifications and Drawings issued at the time of the bid along with any modifications of the bid documents by way of official addendum issued prior to bid opening.

B. The Drawings included in the Contract Documents are entitled "City of Hollywood Southern Regional Wastewater Temporary Sodium Hypochlorite System Volume 2 of 2". The numbers and titles of all Drawings appear on the index sheet of the Drawings. All drawings so enumerated shall be considered an integral part of the Contract Documents as defined herein. Supplemental drawings developed during construction as may be required to be submitted by the Contractor per the specifications shall also be considered a part of the Contract Documents, along with all supplemental drawings issued as part of the response to requests for information (RFIs) during construction or as approved by change order during construction.

D. Contractor shall perform the work in accordance with the Contract Documents, and in accordance with applicable local and national building codes. Where there is an apparent discrepancy between the Drawings, Specifications, or any local and/or national codes, the more stringent of the requirements shall apply unless otherwise approved by the Engineer.

1.04 CONSTRUCTION CONTRACTS, OTHER PROJECTS (NOT USED)

1.05 WORK BY OTHERS (NOT USED)

1.06 WORK BY OWNER

A. Owner will perform the following in connection with the Work:

1. Operate all existing valves, gates, pumps, equipment, and appurtenances that will affect Owner's operation, unless otherwise specified or indicated.

1.07 OWNER-FURNISHED EQUIPMENT AND MATERIALS (NOT USED)

1.08 OWNER ASSIGNED PROCUREMENT DOCUMENTS (NOT USED)

1.09 OWNER PRE-SELECTED EQUIPMENT AND MATERIALS (NOT USED)

1.10 SEQUENCE AND PROGRESS OF WORK

A. Requirements for sequencing and coordinating with Owner's operations, including maintenance of plant operations during construction, and requirements for tie-ins and shutdowns, are in Section 01 14 00 – Coordination with Owner's Operations.

1.11 CONTRACTOR'S USE OF SITE

A. Contractors' use of the Site shall be confined to the areas shown. Contractors shall share use of the Site with City personnel as required to maintain operations.

B. Contractor shall move stored products that interfere with operations of Owner, or others performing work for Owner.

1.12 EASEMENTS AND RIGHTS-OF-WAY

A. Easements and rights-of-way will be provided by Owner in accordance with the General Conditions. Confine construction operations to within Owner's property, public rights-of-way, easements obtained by Owner, and the limits shown. Use care in placing construction tools, equipment, excavated materials, and products to be incorporated into the Work to avoid damaging property and interfering with traffic. Do not enter private property outside the construction limits without permission from the owner of the property.

1.13 NOTICES TO OWNERS AND AUTHORITIES OF PROPERTIES ADJACENT TO THE WORK

A. Notify owners of adjacent property and utilities when execution of the Work may affect their property, facilities, or use of property.

B. When it is necessary to temporarily obstruct access to property, or when utility service connection will be interrupted, provide notices sufficiently in advance to enable affected persons to provide for their needs. Conform notices to Laws and Regulations and, whether delivered orally or in writing, include appropriate information concerning the interruption and instructions on how to limit inconvenience caused.

C. Notify utility owners and other concerned entities at least 48 hours prior to cutting or closing streets or other traffic areas or excavating near Underground Facilities or exposed utilities.

1.14 SALVAGE OF EQUIPMENT AND MATERIALS

A. Existing equipment and materials removed and not shown or specified to be reused in the Work will be Contractor's property.

B. Existing equipment and material removed by Contractor shall not be reused in the Work, except where specified or indicated.

C. Carefully remove in a manner to prevent damage to all equipment and materials specified or indicated to be salvaged and reused or to remain property of Owner. Store and protect salvaged items specified or indicated to be used in the Work. Replace in kind or with new items equipment, materials, and components damaged in removal, storage, or handling through carelessness or improper procedures.

D. Contractor may furnish and install new items, with Engineer's approval, instead of those specified or indicated to be salvaged and reused, in which case such removed items will become Contractor's property.

1.15 PARTIAL UTILIZATION BY OWNER

A. Owner reserves the right to enter and use portions of the Work prior to issuance of Certificate of Substantial Completion by Engineer.

B. Owner shall be responsible to prevent premature connections by private and public parties, persons or groups of persons, before Engineer issues Certificate of Substantial Completion for the portion of Work being partially utilized by Owner.

C. Contractor shall cooperate with Owner, Owner's agents, and Engineer to accelerate completion of Work designed for partial utilization by Owner in accordance with Contractor's progress schedule.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

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SECTION 01 14 00

COORDINATION WITH OWNER'S OPERATIONS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Requirements for coordinating with Owner's operations during the Work and included requirements for tie-ins and shutdowns necessary to complete the Work without impact on Owner's operations except as allowed in this Section.

2. Contractor shall provide labor, materials, tools, equipment and incidentals shown, specified and required to coordinate with Owner's operations during the Work.

B. General Requirements:

1. Except for shutdowns specified in this Section, perform the Work such that Owner's facility remains in continuous satisfactory operation during the Project. Schedule and conduct the Work such that the Work does not: impede Owner's production or processes, create potential hazards to operating equipment and personnel, reduce the quality of the facility's products or effluent, or cause odors or other nuisances.

2. Work not specifically covered in this Section or in referenced Sections may, in general, be completed at any time during regular working hours in accordance with the General Conditions and Supplementary Conditions, subject to the requirements in this Section.

3. Contractor has the option of providing additional temporary facilities that can eliminate or mitigate a constraint without additional cost to Owner, provided such additional temporary facilities: do not present hazards to the public, personnel, structures, and equipment; that such additional temporary facilities do not adversely affect Owner's ability to comply with Laws and Regulations, permits, and operating requirements; that such temporary facilities do not generate or foster the generation of odors and other nuisances; and that requirements of the Contract Documents are fulfilled.

4. Coordinate shutdowns with Owner and Engineer. When possible, combine multiple tie-ins into a single shutdown to minimize impacts on Owner's operations and processes.

5. Do not shut off or disconnect existing operating systems, unless accepted by Engineer in writing. Operation of existing equipment will be by Owner unless

otherwise specified or indicated. Where necessary for the Work, Contractor shall seal or bulkhead Owner-operated gates and valves to prevent leakage that may affect the Work, Owner's operations, or both. Provide temporary watertight plugs, bulkheads, and line stops as required. After completing the Work, remove seals, plugs, bulkhead, and line stops to satisfaction of Engineer.

C. Continuous Treatment Provision:

1. Federal regulations prohibit bypassing of untreated or partially treated wastewater or sewage during construction Work.

2. Contractor shall provide labor, equipment, materials, and incidentals to provide continuous treatment to the level prior to construction Work.

3. Contractor shall be responsible for providing temporary pumping facilities, systems, piping, valve, appurtenances, equipment, materials, and temporary utilities necessary to complete the Work without treatment bypassing.

D. Related Sections:

1. Section 01 11 00 – Summary of Work

2. Section 01 25 00 – Substitution Procedures

3. Section 01 73 00 – Demolition and Execution of Work

1.02 REFERENCES

A. Definitions: A "shutdown" is when a portion of the normal operation of Owner's facility, whether equipment, systems, piping, or conduit, has to be temporarily suspended or taken out of service to perform the Work.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Review installation procedures under other Specification sections and coordinate Work that must be performed with or before the Work specified in this Section.

2. Notify other contractors in advance of Work requiring coordination with Owner's operations, to provide other contractors sufficient time for work included in their contracts that must be installed with or before Work specified in this Section.

3. When possible, combine multiple tie-ins into a single shutdown to minimize impacts on Owner's operations and processes.

B. Pre-Shutdown Meetings: Contractor shall schedule and conduct meeting with Owner and Engineer prior to scheduling shutdown.

C. Sequencing:

1. Perform the Work in the specified sequence. Certain phases or stages of the Work may require working 24-hour days or work during hours outside of regular working hours. Work may be accelerated from a later stage to an earlier stage if Owner's operations are not adversely affected by proposed sequence change, with Engineer's acceptance. Stages specified in this Section are sequential in performance of the Work.

D. Scheduling:

1. Work that may interrupt normal operations shall be accomplished at times convenient to Owner.

2. Furnish at the Site, in proximity to the shutdown and tie-in work areas, tools, equipment, spare parts and materials, both temporary and permanent, necessary to successfully complete the shutdown. Complete to the extent possible, prefabrication of piping and other assemblies prior to the associated shutdown. Demonstrate to Engineer's satisfaction that Contractor has complied with these requirements before commencing the shutdown.

3. If Contractor's operations cause an unscheduled interruption of Owner's operations, immediately re-establish satisfactory operation for Owner.

4. Unscheduled shutdowns or interruptions of continued safe and satisfactory operation of Owner's facilities that result in fines or penalties by authorities having jurisdiction shall be paid solely by Contractor if, in Engineer's opinion, Contractor did not conform to the requirements of the Contract Documents, or was negligent in the Work, or did not exercise proper precautions in conducting the Work.

5. Work requiring service interruptions for tie-ins shall be performed during scheduled shutdowns.

6. Temporary, short-term shutdowns of smaller piping, conduits, equipment, and systems may be required. Coordinate requirements for such shutdowns with Engineer and Owner.

1.04 SUBMITTALS

A. Action/Informational Submittals:

1. Substitute Sequence Submittal: When deviation from specified sequence is proposed, provide submittal explaining in detail the proposed sequence change and its effects, including evidence that Owner's operations will not be adversely affected by proposed change. List benefits of proposed sequence change, including benefits to Progress Schedule. Submit in accordance with Section 01 25 00 – Substitution Procedures.

2. Shutdown Planning Submittal:

    a. For each shutdown, submit an inventory of labor and materials required to perform the shutdown and tie-in tasks, an estimate of time required to accomplish the complete shutdown including time for Owner to take down and start up existing equipment, systems, or conduits, and written description of steps required to complete the Work associated with the shutdown.

    b. Furnish submittal to Engineer at least thirty (30) days prior to proposed shutdown start date. Do not start shutdown until obtaining Engineer's acceptance of shutdown planning submittal.

3. Shutdown Notification: After acceptance of shutdown planning submittal and prior to starting the shutdown, provide written notification to Owner and Engineer of date and time each shutdown is to start. Provide notification at least 72 hours in advance of each shutdown.

1.05 SITE CONDITIONS

A. General Constraints: Specified in the Contract Documents are the sequence and shutdown durations, where applicable, for Owner's equipment, systems, and conduits that are to be taken out of service temporarily for the Work. New equipment, materials, and systems may be used by Owner after the specified field quality controls and testing are successfully completed and the materials or equipment are Substantially Complete.

B. The following constraints apply to coordination with Owner's operations:

1. Operational Access: Owner's personnel shall have access to equipment and areas that remain in operation.

2. Schedule and perform equipment and system start-ups for Monday through Thursday. Equipment and systems shall not be placed into operation on Friday, Saturday, and Sunday without prior approval of Owner.

3. Dead End Valves or Pipe: Provide blind flanges, watertight bulkheads, or valves at temporary and permanent terminuses of pipes and conduits. Blind flanges and bulkheads shall be suitable for the service and braced and blocked, as required, or otherwise restrained as directed by Engineer. Temporary valves shall be suitable for their associated service. Where valve is provided at permanent terminus of pipe or conduit, also provide on downstream side of valve a blind flange with drain/flushing connection.

4. Owner will assist Contractor to the extent practical in dewatering process tanks, basins, conduits, and other work areas to be dewatered for shutdowns. Maintain clean and dry work area by pumping and properly disposing of fluid that accumulates in work areas.

5. Owner will pump out diesel fuel from existing diesel fuel storage tank to the extent practical. The Contractor is advised there may be some remaining fuel in this tank prior to demolition activities.

6. Draining and Cleaning of Conduits, Tanks, and Basins: Unless otherwise specified, Owner will be responsible for draining of any basins and utility isolation via isolation valve operation prior to shutdown. The Contractor shall be responsible for pumping out/removing the remaining contents of affected, tanks, basins, and piping as required to successfully perform the work prior to commencing associated work. All contents shall be disposed of in accordance with all regulatory requirements. Draining and cleaning conducted by Contractor shall be as specified below:

    a. Contractor shall remove liquids and solids and dispose of them in accordance with all regulatory requirements. With prior written approval from Owner, liquid contents of pipes, tanks, basins, and conduits undergoing modifications may be transferred to a process tank or basin identified by Owner with capacity sufficient to accept such discharges, using hoses, piping, pumps, or other means provided by Contractor. All proposed disposal facilities shall be approved by the Owner.

    b. If drainage point is not available on the piping or conduit to be drained, provide a wet tap using tapping saddle and valve or other method approved by Engineer. Uncontrolled spillage of pipe's or conduit's contents is not allowed.

    c. Spillage shall be brought to Engineer's attention immediately, both verbally and in writing, and reported in accordance with Laws and Regulations. Contractor shall wash down spillage to floor drains or sumps and flush the system to prevent clogging and odors. If spillage is not suitable for discharge to the drainage system, such as chemical spills, as determined by Engineer, Contractor shall remove spillage by other method, such as vactor truck, acceptable to Engineer.

1. Electrical, Control, Communication, and Monitoring Systems:

    a. Owner's existing SCADA system and fiber optic network shall remain functional, subject to the constraints herein.

    b. The Contractor shall submit a detailed Work Plan to the Engineer for review and approval prior to connecting the new temporary system to the Owner's SCADA or electrical infrastructure.

    c. Once the temporary sodium hypochlorite system is energized and online, continuous communication to all related PLC panels, instruments, and SCADA interfaces shall be maintained. Any disruption to SCADA

connectivity after startup shall require prior written approval and shall follow the approved shutdown procedure.

d. Each process area shall be permitted to have a single, non-concurrent, scheduled outage for the purpose of making PLC panel hardware modifications, loading the associated PLC logic, and its field testing/demonstration if needed. Field testing and demonstration shall immediately follow modifications in an effort to keep scheduled shutdowns as short as possible. A 14-day period of no SCADA outage shall proceed each scheduled shutdown.

1.06 SUGGESTED SEQUENCE OF WORK

A. Perform the Work in the specified sequence or as otherwise approved by Engineer. Certain phases or stages of the Work may require working 24-hour days or work during hours outside of regular working hours. Work may be accelerated from a later stage to an earlier stage if Owner's operations are not adversely affected by proposed sequence change, and with Engineer's acceptance.

B. Critical events in the sequence of construction are specified herein. The outlined sequence of construction does not include all items necessary to complete the Work, but is intended to identify the sequence of critical events necessary to eliminate disruption to the Owner's facilities. It shall be understood by the Contractor that the critical events identified are not all inclusive and that additional items of work not shown are required. The sequence of construction is a precedence requirement and does not attempt to schedule the Contractor's work.

C. Detailed Sequence of Construction and Operational Constraints

1. Mobilization and Site Preparation:

a. Obtain permits, develop and submit construction schedule, schedule of values, hurricane preparedness/action plan, plan of operations, shop drawing schedule, set up staging area, and mobilize for work

b. Complete pre-construction video and perform field investigations/locates of existing utilities that may be impacted by the work

c. Complete all pre-construction requirements

2. Temporary Sodium Hypochlorite System:

a. Prior to the start of construction of the new Temporary Sodium hypochlorite Facility, the following work must be performed:

1) Site demolition of paving and other structures in the vicinity of the work.

2) Permanent relocation of the existing 6” and 16” NPW pipelines and 6” PW pipeline affected by the footprint of the new Facility.

3) Temporary relocation of three (3) existing 3” CLS pipelines to the Reuse and Non-Potable Filter Pre-Chlorination and Chlorine Contact Tank Dosing locations. Temporary highlines or other suitable means of disinfectant dosing must be implemented by the Contractor to allow Owner the ability maintain chlorine dosing to these locations.

b. The existing gas chlorination and chlorine solution water system at the Chlorine Building are critical components of the Owner’s wastewater treatment plant system and shall remain in service, at all times to critical portions of the facility including the Outfall Pump Station (via the Hydraulic Box), Reuse and Non-Potable Filters Pre-Chlorination, Reuse Chlorine Contact Tank, and Non-Potable Chlorine Contact Tanks. Temporary shutdowns that affect these operations must be coordinated with the Owner and Engineer.

c. The Contractor shall notify the Owner in writing 14 calendar days in advance of any work done to the Temporary Sodium Hypochlorite System that will impact operation of the existing chlorine solution water system.

d. The Temporary Sodium Hypochlorite System shall be installed as described in the Contract Documents. Successful completion of 30 days consecutive and continuous days of satisfactory shall be provided to confirm performance shall be provided to confirm performance of the continuous chlorine dosing location points. Failure results in re-start of 30-day period. Successful completion of 7 days consecutive and continuous days of satisfactory operation shall be provided to confirm performance of the intermittent chlorine dosing location points. Failure results in re-start of 7-day period. The Contractor may assist Owner in shutting down the existing gas chlorination system at the Chlorine Building. (**Note: This Project DOES NOT include demolition or equipment removals of any portion of the existing gas chlorination system within the Chlorine Building**).

e. Complete all work at the locations of new NaOCl Injection Dosing Stations, including new NaOCl dosing lines installations, sump drain installations, and new CLS pipeline tie-ins to existing CLS dosing locations as shown on the Contract Documents. Upon successful completion of 30 consecutive and continuous days of satisfactory operation for continuous dosing locations, and 7 consecutive and continuous days for intermittent dosing locations of the Temporary Sodium Hypochlorite System, the Contractor shall be permitted to proceed with the abandonment and/or removal of the affected portions of the existing CLS piping from the Chlorine Building.

f. Complete all work at the locations of new NaOCl Injection Dosing Stations, including new NaOCl dosing lines installations, sump drain installations, and new CLS pipeline tie-ins to existing CLS dosing locations as shown on the Contract Documents. Upon completion of the 30 (continuous locations) and 7 (intermittent locations) consecutive and continuous days of satisfactory operation of Temporary Sodium Hypochlorite System, the Contractor may complete abandonments and/or removals of affected portions of the existing CLS piping from the Chlorine Building.

3. Tie-Ins:

a. See Scheduled Shutdowns in paragraph 3.02 and Schedule of Tie-Ins in Table 01 14 00-A of this Section for specific items of work.

b. The Contractor shall notify the Owner in writing 14 calendar days in advance of tie-in work.

c. Tie-ins to existing piping shall occur during non-peak periods. Non-peak periods are anticipated to occur between 10PM and 5AM daily. Contractor shall plan construction activities for Tie-In Nos. 5, 6, and 7 (See Table 01 14 00-A) such that operation is interrupted on no more than two occasions for up to four hours on each occasion.

d. The New Temporary Sodium Hypochlorite Facility shall be installed, tested, and cleared for operation by the Florida Department of Environmental Protection and Broward County Resilient Environment Department prior to being placed into operation.

e. New Temporary Sodium Hypochlorite Facility shall be placed into operation and complete operational testing prior to taking the Existing Chlorine Gas System off-line and abandoning in place.

4. Project Closeout

a. Complete final punch list items

b. Complete project closeout activities in accordance with Section 01 77 19

c. Final acceptance of project

d. Commence warranty period

1.07 SHUTDOWNS

A. General:

1. Work that may interrupt normal operations shall be accomplished at times convenient to Owner.

2. Furnish at the Site, in proximity to the shutdown and tie-in work areas, tools, equipment, spare parts and materials, both temporary and permanent, necessary to successfully complete the shutdown. Complete to the extent possible, prefabrication of piping and other assemblies prior to the associated shutdown. Demonstrate to Engineer's satisfaction that Contractor has complied with these requirements before commencing the shutdown.

3. If Contractor's operations cause an unscheduled interruption of Owner's operations, immediately re-establish satisfactory operation for Owner.

4. Unscheduled shutdowns or interruptions of continued safe and satisfactory operation of Owner's facilities that result in fines or penalties by authorities having jurisdiction shall be paid solely by Contractor if, in Engineer's opinion, Contractor did not conform to the requirements of the Contract Documents, or was negligent in the Work, or did not exercise proper precautions in conducting the Work.

5. Shutdowns shall be in accordance with paragraph 3.02 of this Section. Work requiring service interruptions for tie-ins shall be performed during scheduled shutdowns.

1.08 PLAN OF OPERATION

A. Contractor shall submit a detailed, written Work Plan for each detailed sequence item described below to the Owner and the Engineer for their review and approval. The Work Plan shall be submitted at least four weeks prior to commencing the work described. The Work Plan shall address the following items:

1. Step by step detailed sequence for performing the work described in Paragraph 1.08 (A), including all activities required by the Owner.

2. Anticipated dates and duration of each activity, including all activities required by the Owner

3. The Work Plan shall include a detailed plan for tie-ins and shutdowns

4. Plan and/or schematic drawings to clearly identify work to be performed. Sequence steps shall be identified in drawings using a keynote legend or similar means.

5. The Plan of Operation shall include a detailed plan for tie-ins or shutdowns. The plan shall list all potential problems and remedies along with spare parts and materials that must be on hand to repair any potential problems.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.01 GENERAL

A. In addition to requirements of this Section, conform to requirements of Section 01 73 00 – Demolition and Execution of Work.

B. Refer to paragraph 3.02 of this Section for detailed shutdown requirements.

C. Refer to Table 01 14 00-A in this Section for detailed tie-in schedule.

3.02 DETAILED SHUTDOWN REQUIREMENTS:

A. Prior to Typical Shutdown:

1. Obtain Engineer's acceptance of proposed shutdown planning submittal and shutdown notification submittal.

2. Submittal and approval of all shop drawings required.

3. Coordinate with plant operations on timing of shutdown and provide required notice to Owner.

4. Bring necessary piping, couplings, valves, equipment, and appurtenances to the work areas.

5. Assist Owner in preparing to take equipment, tanks, basins, and conduits temporarily out of service.

6. Coordinate other tie-ins to be performed simultaneously.

7. Install and ensure the functionality of temporary systems as applicable.

B. During Typical Shutdown:

1. Owner will dewater tanks and basins as required and provide temporary shutdown of portions of the facilities as necessary to allow Contractor's expedited completion of tie-in work.

2. Remove existing equipment, piping, and accessories as required.

3. Verify operation of new equipment, materials, and systems.

4. Following approval from Engineer, return equipment and system to operation with Owner.

C. Following Typical Shutdown:

1. Verify functionality of equipment and system.

2. Verify operation of new equipment and systems and verify that joints in piping are watertight or gastight as applicable.

3. Repair joints that are not watertight or gastight as applicable.

4. Remove temporary systems as applicable.

3.03 PROPOSED SHUTDOWN SEQUENCE

A. Shutdown No. 1 Description: 16” NPW Relocation at Chlorine Building

1. General:

a. Impact on Other Equipment and Processes: Shutdown or partial shutdown of the 16” NPW may affect ability to provide primary motive water for the chlorine solution water system at Chlorine Building. Maintain 6” PW connection to Chlorine Building in service to supply backup motive water supply to the chlorine solution water system.

b. Location: East of Chlorine Building and south of new Temporary Sodium Hypochlorite Structure

c. Owner access to Site roadways: Maintain in service during shutdown and relocation of the 16” NPW pipeline.

2. Prior to Shutdown:

a. Obtain Engineer’s acceptance of proposed shutdown planning submittal and shutdown notification submittal.

b. Assist Owner in preparing to take equipment, tanks, basins, and conduits temporarily out of service.

c. Specific requirements: Assist Owner in verifying operation of the backup potable water supply to the Chloring Building including the following:

1) Backflow preventer and booster pump

2) Gas chlorinators and eductor systems

3. During Shutdown:

a. Installation of remaining Work required.

b. Perform disinfection and pressure test.

c. Perform Tie-In No. 1 shown on Table 01 14 00-A. Consider performing Tie-In Nos. 3 and 4 shown on Table 01 14 00-A during this shutdown.

d. Verify functionality of equipment and system.

e. Complete trench backfill, compaction and restoration.

4. Following shutdown:

a. Restore 16” NPW to service

B. Shutdown No. 2 Description: 6” PW Relocation at Chlorine Building

1. General:

a. Impact on Other Equipment and Processes: Shutdown or partial shutdown of the 6” PW may affect ability to provide back-up motive water for the chlorine solution water system and supply to eye-wash showers and other potable uses at Chlorine Building. Maintain 16” NPW connection to Chlorine Building in service to supply primary motive water supply to the chlorine solution water system.

b. Location: East of Chlorine Building and south of new Temporary Sodium Hypochlorite Structure

c. Owner access to Site roadways: Maintain in service during shutdown and relocation of the 6” PW pipeline.

2. Prior to Shutdown:

a. Obtain Engineer’s acceptance of proposed shutdown planning submittal and shutdown notification submittal.

b. Assist Owner in preparing to take equipment, tanks, basins, and conduits temporarily out of service.

c. Specific requirements: Assist Owner in verifying operation of the primary non-potable water supply to the Chlorine Building including the following:

1) Backflow preventer and booster pump

2) Gas chlorinators and eductor systems

3. During Shutdown:

a. Installation of remaining Work required.

b. Perform disinfection, bacteriological testing, and pressure test.

c. Perform Tie-In No. 2 shown on Table 01 14 00-A.

d. Verify functionality of equipment and system.

e. Complete trench backfill, compaction and restoration.

4. Following shutdown:

a. Restore 6” PW to service

C. Shutdown No. 3 Description: 3” CLS from Chorine Building to Reuse CCT

1. General:

a. Impact on Other Equipment and Processes: Shutdown of the 3” CLS from Chorine Building to Reuse CCT will affect the ability to chlorinate the Reuse Filtered Water. Shutdown cannot occur until the New NaOCl Dosing Station for the Reuse and Non-Potable CCTs has been constructed and ready for service.

b. Location: West of Reuse and Non-Potable Filter Chlorine Contact Tanks

c. Owner access to Site roadways: Portions of the maintenance roadway adjacent to west side of the CCTs will require shutdown due to open trench excavation.

2. Prior to Shutdown:

a. Obtain Engineer’s acceptance of proposed shutdown planning submittal and shutdown notification submittal.

b. Assist Owner in preparing to take equipment, tanks, basins, and conduits temporarily out of service.

c. Specific requirements: Assist Owner in shutting down, isolating, and abandoning existing 3” CLS from Chorine Building to Reuse CCT.

3. During Shutdown:

a. Installation of remaining Work required.

b. Perform disinfection and pressure test of new piping.

c. Perform Tie-In No. 5 shown on Table 01 14 00-A.

d. Verify functionality of equipment and system.

e. Complete trench, backfill, compaction and restoration.

4. Following shutdown:

a. In coordination with Owner and Engineer, test and place new disinfection system to Reuse CCT into service.

D. Shutdown No. 4 Description: 3” CLS from Chorine Building to Non-Potable CCT

1. General:

a. Impact on Other Equipment and Processes: Shutdown of the 3” CLS from Chorine Building to Non-Potable CCT will affect the ability to chlorinate the Non-Potable Filtered Water. Shutdown cannot occur until the New NaOCl Dosing Station for the Reuse and Non-Potable CCTs has been constructed and ready for service.

b. Location: West of Reuse and Non-Potable Filter Chlorine Contact Tanks

c. Owner access to Site roadways: Portions of the maintenance roadway adjacent to west side of the CCTs will require shutdown due to open trench excavation.

2. Prior to Shutdown:

a. Obtain Engineer’s acceptance of proposed shutdown planning submittal and shutdown notification submittal.

b. Assist Owner in preparing to take equipment, tanks, basins, and conduits temporarily out of service.

c. Specific requirements: Assist Owner in shutting down, isolating, and abandoning existing 3” CLS from Chorine Building to Non-Potable CCT.

3. During Shutdown:

a. Installation of remaining Work required.

b. Perform disinfection and pressure test of new piping.

c. Perform Tie-In No. 6 shown on Table 01 14 00-A.

d. Verify functionality of equipment and system.

e. Complete trench, backfill, compaction and restoration.

4. Following shutdown:

a. In coordination with Owner and Engineer, test and place new disinfection system to Non-Potable CCT into service.

E. Shutdown No. 5 Description: 6” CLS from Chorine Building to Hydraulic Box

1. General:

a. Impact on Other Equipment and Processes: Shutdown of the 6” CLS from Chorine Building to Hydraulic Box will affect the ability to chlorinate the secondary effluent to the Outfall Pump Station. Shutdown cannot occur until the New NaOCl Dosing Station for the Hydraulic Box and Injection Well Diversion Structures has been constructed and ready for service. Consider sending all secondary effluent to the Injection Well System. The Injection Well System is expected to be able to accept all dry weather secondary effluent flows by 4th quarter of 2025.

b. Location: North end of Hydraulic Box at the Filter Feed and Outfall Pump Stations.

c. Owner access to Site roadways: Portions of the maintenance roadway north of the Chlorine Building may require temporary shut down due open trench excavation across roadway.

2. Prior to Shutdown:

a. Obtain Engineer’s acceptance of proposed shutdown planning submittal and shutdown notification submittal.

b. Assist Owner in preparing to take equipment, tanks, basins, and conduits temporarily out of service.

c. Specific requirements:

1) Assist Owner in diverting secondary effluent flows to Injection Well System.

2) Provide temporary means for emergency dosing of bulk sodium hypochlorite at the Hydraulic Box in case of wet weather event or to otherwise prevent unchlorinated secondary effluent flows to the outfall.

3) Assist Owner in shutting down, isolating, and abandoning existing 6” CLS from Chorine Building to Hydraulic Box.

3. During Shutdown:

a. Installation of remaining Work required.

b. Perform pressure test of new piping.

c. Perform Tie-In No. 7 shown on Table 01 14 00-A.

d. Verify functionality of equipment and system.

e. Complete trench, backfill, compaction and restoration.

4. Following shutdown:

a. In coordination with Owner and Engineer, test and place new disinfection system to Hydraulic Box into service.

F. Shutdown No. 6 Description: 3” CLS from Chorine Building to Injection Well Diversion Structure

1. General:

a. Impact on Other Equipment and Processes: Shutdown of the 3” CLS from Chorine Building to Injection Well Diversion Structure will affect the ability to perform maintenance chlorination of the secondary effluent to the Injection Well System. Shutdown cannot occur until the New NaOCl Dosing Station for the Hydraulic Box and Injection Well Diversion Structures has been constructed and ready for service. Chlorination at this location is for maintenance purposes only and is not critical to the operation of the Injection Well System

b. Location: Injection Well Diversion Structure at south end of Secondary Clarifiers.

c. Owner access to Site roadways: Portions of the maintenance roadway south of the Secondary Clarifiers may partially impacted but not completely shutdown due open trench excavation across roadway.

2. Prior to Shutdown:

a. Obtain Engineer’s acceptance of proposed shutdown planning submittal and shutdown notification submittal.

b. Assist Owner in preparing to take equipment, tanks, basins, and conduits temporarily out of service.

c. Specific requirements:

1) Assist Owner in shutting down, isolating, and abandoning portions of the existing 3” CLS from isolation valve to the Injection Well Diversion Structure.

3. During Shutdown:

    a. Installation of remaining Work required.

    b. Perform pressure test of new piping.

    c. Perform Tie-In No. 8 shown on Table 01 14 00-A.

    d. Verify functionality of equipment and system.

    e. Complete trench, backfill, compaction and restoration.

4. Following shutdown:

    a. In coordination with Owner and Engineer, test and place new disinfection system to Injection Well Diversion Structure into service.

G. Shutdown No. 7 Description: 3” CLS from Chorine Building to Headworks Odor Control

1. General:

    a. Impact on Other Equipment and Processes: Shutdown of the 3” CLS from Chorine Building to Headworks Odor Control may temporarily affect the odor removal efficiency of the Odor Control System which relies on sodium hydroxide and sodium hypochlorite for high levels of odor removal. The Odor Control System will still function on sodium hydroxide only until sodium hypochlorite injection is restored.

    b. Location: Headworks Odor Control System.

    c. Owner access to Site roadways: Portions of the maintenance roadways along the alignment of the new double containment pipe installation may be partially impacted but not completely shutdown due open trench excavation along the affected roadways. Contractor will need to coordinate site roadway access and temporary closures with Owner.

2. Prior to Shutdown:

    a. Obtain Engineer’s acceptance of proposed shutdown planning submittal and shutdown notification submittal.

    b. Assist Owner in preparing to take equipment, tanks, basins, and conduits temporarily out of service.

    c. Specific requirements:

        1) Assist Owner in shutting down, isolating, and abandoning the existing 3” CLS from the Chlorine Building to the Headworks odor Control.

3. During Shutdown:

    a. Installation of remaining Work required.

    b. Perform pressure test of new piping.

    c. Perform Tie-In No. 9 shown on Table 01 14 00-A.

    d. Verify functionality of equipment and system.

    e. Complete trench, backfill, compaction and restoration.

4. Following shutdown:

    a. In coordination with Owner and Engineer, test and place new disinfection system to Headworks Odor Control into service.

H. Shutdown No. 3 Description: Five (5) 3” CLS pipelines at Chorine Building for RAS 1, 2, 3, and 4, and Influent Pump Station

1. General:

    a. Impact on Other Equipment and Processes: Temporary shutdown of the respective 3” CLS pipelines at the Chorine Building to RAS 1, 2, 3, and 4, and Influent Pump Station will prevent to ability to send chlorine to the respective processes for maintenance purposes. However, Owner has noted that this is not critical as maintenance injection of chlorine at the respective processes are not performed on a regular basis.

    b. Location: South wall of Chlorine Building near east end.

    c. Owner access to Site roadways: No site roadways will be impacted

2. Prior to Shutdown:

    a. Obtain Engineer’s acceptance of proposed shutdown planning submittal and shutdown notification submittal.

    b. Assist Owner in preparing to take equipment, tanks, basins, and conduits temporarily out of service.

    c. Specific requirements:

        1) Assist Owner in shutting down and isolating the affected existing 3” CLS pipelines for RAS 1, 2, 3, and 4, and Influent Pump Station.

2) Partially remove existing outer insulation cover or secondary containment pipe on vertical CLS pipes to the proposed locations for new injector installations.

3. During Shutdown:

   a. Install new injectors into the vertical legs of each of the affected 3” CLS lines.

   b. Install new RAS 1, 2, 3, and 4 Dosing Valve Diverter Panel

   c. Install remaining Work required.

   d. Perform pressure test of new piping.

   e. Perform Tie-In Nos. 10 and 11 shown on Table 01 14 00-A.

   f. Verify functionality of equipment and system.

   g. Complete trench, backfill, compaction and restoration.

4. Following shutdown:

   a. In coordination with Owner and Engineer, test and place new disinfection system to RAS 1, 2, 3, and 4, and Injection Pump Station into service.

Table 01 14 00-A
Schedule of Tie-Ins

Tie-In No.	New Line Size and Service	Existing (Connecting) Line Size & Service	Tie-In Building/Location	Construction Stage	Remarks
1	16” NPW	16” NPW	Chlorine Building	1	Realign existing 16” NPW
2	6” PW	6” PW	Chlorine Building	1	Realign existing 6” PW
3	4” NPW	16” NPW	New NaOCl Dosing Station for Reuse and Non-Potable CCTs	1	Hot tap to keep 16” NPW in service
4	4” NPW	16” NPW	New NaOCl Dosing Station for Hydraulic Box & Injection Well Diversion Structures	1	Hot tap to keep 16” NPW in service
5	3” CLS from New NaOCl Dosing Station for Reuse CCT	3” CLS from Chorine Building to Reuse CCT	Reuse CCT	3	Existing 3” CLS from Chlorine Building to Reuse CCT must be shutdown and taken out of service to perform new tie-in.
6	3” CLS from New NaOCl Dosing Station for Non-Potable CCT	3” CLS from Chorine Building to Non-Potable CCT	Non-Potable CCT	3	Existing 3” CLS from Chlorine Building to Non-Potable CCT must be shutdown and taken out of service to perform new tie-in.
7	6” CLS from New NaOCl Dosing Station for Hydraulic Box	6” CLS from Chorine Building to Reuse CCT	Hydraulic Box upstream of Filter Feed and Outfall Pump Stations	3	Existing 6” CLS from Chlorine Building to Hydraulic Box must be shutdown and taken out of service to perform new tie-in.
8	3” CLS from New NaOCl Dosing Station for Injection Well Diversion Structure	3” CLS from Chlorine Building to Injection Well Diversion Structure	Injection Well Diversion Structure	3	Confirm that existing 3” CLS to Injection Well Diversion Structure can be isolated from main line via isolation valve. Otherwise, entire 3” CLS will need to be shutdown from Chlorine Building to new tie-in.

Table 01 14 00-A
Schedule of Tie-Ins

Tie-In No.	New Line Size and Service	Existing (Connecting) Line Size & Service	Tie-In Building/Location	Construction Stage	Remarks
9	2” Dbl Containment Pipe with 0.375” I.D. NaOCl Carrier Tubing from New Headworks Odor Control Meter Pumps	3” CLS	Headworks Odor Control	3	Replace existing 3” CLS from Chlorine Building to Headworks Odor Control with New NaOCl. Coordinate tie-in location with separate Headworks Odor Control Contractor.
10	3” Dbl Containment Pipe with 0.75” I.D. NaOCl Carrier Tubing from new RAS 1,2,3,4 Metering Pump	3” CLS to RAS 1, 2, 3, & 4	Chlorine Building	4	Existing 3” CLS lines to RAS 1, 2, 3, and 4 at Chlorine Building must be shutdown and taken out of service to perform new dosing point tie-ins. Install RAS Dosing Diverter Valve Panel on wall upstream of tie-in points.
11	3” Dbl Containment Pipe with 0.75” I.D. NaOCl Carrier Tubing from new Influent Pump Station Metering Pump	3” CLS to Influent Pump Station	Chlorine Building	4	Existing 3” CLS lines to Influent Pump Station at Chlorine Building must be shutdown and taken out of service to perform new dosing point tie-in.

END OF SECTION

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SECTION 01 20 00

MEASUREMENT AND PAYMENT

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes:

1. Items listed in this Section refer to and are the same pay items listed in the Bid Form and constitute all pay items for completing the Work.

2. Compensation for all services, items, materials, and equipment shall be included in prices stipulated for lump sum and unit price pay items listed in this Section and included in the Contract.

3. No direct or separate payment will be made for providing miscellaneous temporary or accessory works, bonds, insurance, or other requirements of the General Conditions, Supplementary Conditions, General Requirements, and other requirements of the Contract Documents.

4. Each lump sum and unit bid price shall include an amount considered by Contractor to be adequate to cover Contractor's overhead and profit for each separately identified item.

B. Related Sections:

1. Payments to Contractor: Refer to General Conditions, Supplementary Conditions, and Agreement.

2. Changes to Contract Price: Refer to General Conditions and Supplementary Conditions

3. Schedule of Values: Refer to General Conditions, Supplementary Conditions, and Section 01 29 73 – Schedule of Values.

1.02 ENGINEER'S ESTIMATE OF QUANTITIES

A. ENGINEER'S and OWNER's estimated quantities for unit price pay items, as listed in the Bid Form, are approximate only and are included solely for the purpose of comparison of Bids. Owner does not expressly or by implication agree that the nature of the materials encountered below the surface of the ground or the actual quantities of material encountered or required will correspond therewith and reserves the right to increase or decrease any quantity or to eliminate any quantity as Owner may deem necessary. Contractor will not be entitled to any adjustment in a unit bid price as a result of any change in an estimated quantity and agrees to accept the aforesaid unit bid prices

as complete and total compensation for any additions caused by changes or alterations in the Work ordered by Owner.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Contractor shall include all additional Work items, services, goods, resources, and manpower necessary for installation of the Work to provide a completely functional system in accordance with the Contract Documents. Contractor shall include these costs associated with providing a completely functional system within the listed items on the Bid Form and as specified herein.

1.04 PAYMENT ITEMS

A. Bid Items

1. Item No. 1 - Mobilization: The lump sum bid price for this item shall constitute full compensation for all mobilization activities, including but not limited to bonds, insurance, scheduling, labor associated with permit acquisition, temporary facilities, audio-video documentation of the existing site, preparation and submittal of shop drawings and all other activities necessary to prepare to complete the contract work. The payment item for mobilization shall not exceed 5% of Bid Item Nos. 2 through 5.

2. Item No. 2 – Demolition and Re-route Existing Piping: The lump sum bid price for this item shall constitute full compensation for demolition including sawcutting and removal of pavement, curbing, sidewalks, and removal or abandoning of designated utilities in the vicinity of the work. This item includes re-routing of existing potable water, non-potable water and chlorine solution piping as shown on the Drawings. This item includes, but is not limited to, locating, verifying and protecting existing utilities in the vicinity of the existing and proposed piping, excavation, demolition of existing pipe, disposal of material, connection of new piping, installation of fittings, valves, and joint restraints, pipe bedding, backfill, compaction, concrete encasement as necessary, flushing, disinfection, permitting, testing, restoration, and all other related work required for a complete installation.

3. Item No. 3 – Hypochlorite Storage and Feed Facility: The lump sum bid price for this item shall constitute full compensation for all labor, equipment, and material for all Work necessary and required for complete furnishing, delivery and installation of the sodium hypochlorite storage and feed facility including bulk storage tanks, chemical metering pump assemblies, transfer pumps, fill stations, chemical vent piping, chemical feed piping, chemical dosing stations, chemical injection facilities, pipe hangers and supports, equipment pads, equipment canopies, and other appurtenances as required. This item includes, but is not limited to, all general, civil, mechanical, structural, architectural, electrical, instrumentation and control, equipment testing, startup and commissioning services including operation

verification, and construction sequencing required for a complete and operable system. This item includes all work not defined in other Bid Items.

4. Item No. 4 – Asphalt Replacement: Payment shall be made at the unit price per square yard for all labor, equipment, material and all work necessary and required for complete replacement of asphalt roadway as shown on the Drawings. This item includes, but is not limited to, furnishing, placing and compaction of subgrade; furnishing, placing and compaction of aggregate base course; applying a prime or tack coat; applying an asphalt concrete surface complete in place to the cross section and thickness shown on the Drawings; incidental replacement of concrete curbing affected by pipe trenching; transportation, handling, cleaning, compacting and disposal of waste or unsuitable material; adjustment of finished grades of manhole rims and valve boxes of existing utilities; furnishing and installing pavement markings, directional arrows and reflective pavement markings and all other appurtenant and miscellaneous work required per the Contract Documents.

5. Item No. 5 – Sidewalk Replacement: Payment shall be made at the unit price per square yard for all labor, equipment, material and all work necessary and required for the restoration of sidewalk as shown on the Drawings. This item includes, but is not limited to, subgrade preparation and compaction, form work, imported fill material if required, and disposal of excess waste or unsuitable material, installation of sidewalk and all other appurtenant and miscellaneous work required per the Contract Documents.

6. Item No. 6 – Demobilization: Payment for completing all other work including but not limited to finish grading, demobilization, site cleanup and restoration - all as per the Contract Documents. The payment item for demobilization shall not exceed 3% of Bid Item Nos. 2 through 5.

7. Item No. 7 – Consideration for Indemnification: In recognition of CONTRACTOR's indemnification obligations, the OWNER will pay to the CONTRACTOR the specific consideration of ten dollars ($10.00). Payment of said specific consideration shall be made at the time of the payment of the first progress estimate and the CONTRACTOR shall acknowledge payment of this consideration by letter to the OWNER after receipt of the progress payment.

8. Item No. 8 – Inspections and Testing Allowance: The allowance account indicated for this item is to pay for all labor, materials, equipment and services necessary for providing independent testing services including, but not limited to, soil compaction densities and concrete testing as per the Contract Documents. Any portion of this fund remaining after all authorized payments have been made will be withheld from payment to the CONTRACTOR and will remain with the OWNER.

9. Item No. 9 – Permits, Licenses, and Fees Allowance: The allowance account indicated for this item is to pay for all permits, licenses and other fees required of the CONTRACTOR from the various government agencies having jurisdiction for

construction of the project. The allowance shown on the Bid Form is an estimate of fees required. Payment will be based on the actual permit, license or fee paid directly to agency, documented by paid receipts, specifically excluding any labor, mark-up, overhead and profit, administration or other costs involved in obtaining permits or licenses or paying fees. Fees specifically excluded from this allowance include but are not limited to re-inspection fees and expired permit fees.

10. Item No. 10 – Undefined Conditions Allowance: Included in this allowance is work associated with undefined conditions or conflicts developing from undefined conditions. All work authorized for payment will be authorized in writing by the OWNER. Amount to be paid per undefined condition or conflict shall be negotiated or agreed to by both parties. Any portion of this fund remaining after all authorized payments have been made will be withheld from payment to the CONTRACTOR and will remain with the OWNER.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01 25 00
SUBSTITUTION PROCEDURES

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes:

1. Procedural requirements for product substitutions.

2. Procedural requirements for substitute construction methods or procedures, when construction methods or procedures are specified.

B. Requests for substitutions of equipment and material shall conform to the requirements of the General Conditions and Supplemental Conditions.

C. Procedure for substitution requests and review including evaluation, reimbursement, acceptance, and determination shall be in accordance with General Conditions and Supplemental Conditions.

1.02 REFERENCES

A. Definitions: The following words or terms are not defined but, when used in this Section, have the following meaning:

1. “Acceptable Manufacturers” considered for substitution include Suppliers of equipment and material of proven reliability, and as manufactured by reputable manufacturers having experience in the production of specified equipment and material. Equipment furnished shall be designed, constructed, and installed in accordance with the industry accepted practices and shall operate satisfactorily when installed in accordance with the Contract Documents.

2. “Products” includes materials, equipment, machinery, components, fixtures, systems, and other goods incorporated in the Work. Products do not include machinery and equipment used for preparing, fabricating, conveying, erecting, or installing the Work. Products include Owner-furnished goods incorporated in the Work where use of such goods is specifically required in the Contract Documents.

1.03 ADMINSTRATIVE REQUIREMENTS

A. Contractor’s Responsibilities: In submitting request for substitution, Contractor represents that:

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1. Contractor has investigated proposed substitution and determined that it is equivalent to item, product, method, or procedure specified, as applicable.

2. Contractor will provide the same or better guarantees or warranties for proposed substitution as for the specified product, manufacturer, method, or procedure, as applicable.

3. Contractor waives all Claims for additional costs or extension of time related to proposed substitution that subsequently may become apparent.

4. Contractor shall submit a minimum of five (5) successful installations of the manufacturer's equipment of the same model, size, and type as specified in the Contract Documents.

5. All costs associated with incorporation of a substitution shall be borne by the Contractor, including but not limited to, the cost of redesign and construction provisions.

B. Engineer's Review: A proposed substitution will not be accepted for review if:

1. Approval would require changes in design concept or a substantial revision of the Contract Documents.

2. Approval would delay completion of the Work or the work of other contractors.

3. Substitution request is indicated or implied on a Shop Drawing or other submittal, or on a request for interpretation or clarification, and is not accompanied by Contractor's formal request for substitution.

4. If the substitution is not clearly substantiated by performance criteria as providing an equivalent or superior performing installation.

5. All costs associated with Engineer's review of a substitution shall be recorded by Engineer, submitted to Owner, and charged to Contractor.

C. If Engineer does not approve the proposed substitute, Contractor shall provide the specified product, manufacturer, method, or procedure, as applicable.

D. Approval of a substitution request will not relieve Contractor from requirement for submitting Shop Drawings as set forth in the Contract Documents.

E. Product Substitutions Procedure:

1. Requests for approval of substitute products or items will be considered for a period of 30 days after the Effective Date of the Agreement. After end of specified period, requests will be considered only in case of unavailability of a specified product or other conditions beyond Contractor's control.

2. Submit copies of request for substitution.

3. Submit separate request for each substitution.

4. In addition to requirements of the General Conditions and information required on substitution request forms, include with request the following:

    a. Product identification, including manufacturer's name and address.

    b. Manufacturer's literature with product description, performance and test data, and reference standards with which product complies.

    c. Samples, if appropriate.

    d. Name and address of similar projects on which product was used, and date of installation.

    e. Certified tests, where applicable, by an independent laboratory attesting the proposed substitution is equal.

    f. Cost information for the proposed substitution and the specified products.

    g. Lead time information for the proposed substitution and specified products.

    h. All other submittal requirements indicated in the individual Specification Sections associated with the specified equipment and material.

F. Construction Methods Substitutions Procedures:

1. Where construction methods or procedures are specified, for a period of 30 days after the Effective Date of the Agreement, Engineer will consider Contractor's written requests for substitute construction methods or procedures specified.

2. Submit copies of request for substitution.

3. Submit separate request for each substitution.

4. In addition to requirements of the General Conditions and information required on substitution request forms, include with request the following:

    a. Detailed description of proposed method or procedure.

    b. Itemized comparison of the proposed substitution with the specified method or procedure.

    c. Drawings illustrating method or procedure.

d. Other data required by Engineer to establish that proposed substitution is equivalent to specified method or procedure.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01 26 00
CONTRACT MODIFICATION PROCEDURES

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. Section Includes:

1. General Conditions and Supplementary Conditions provision expansion, including the following:

a. Requests for interpretation.

b. Field Orders

c. Work Change Directives

d. Proposal requests

e. Change Proposals

f. Change Orders

1.02 ADMINISTRATIVE REQUIREMENTS

A. Submit Contract modification documents to Engineer's contact person and address in the Contract Documents.

B. Retain at Contractor's office and at the Site complete copy of each Contract modification document and related documents, and Engineer's response.

1.03 REQUEST FOR INTERPRETATION

A. General:

1. Submit written or electronic requests for interpretation to Engineer. Contractor and Owner may submit requests for interpretation.

2. Submit request for interpretation to obtain clarification or interpretation of the Contract Documents. Report conflicts, errors, ambiguities, and discrepancies in the Contract Documents using requests for interpretation.

3. Do not submit request for interpretation when other form of communication is appropriate, such as submittals, requests for substitutions or "or equals", notices, ordinary correspondence, or other form of communication. Improperly prepared or

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inappropriate requests for interpretation will be returned without response or action.

B. Procedure:

1. Submit one original (hard copy or electronic) of each request for interpretation. Submit each request for interpretation with separate letter of transmittal if hard copies are submitted.

2. Engineer will provide timely review of requests for interpretation. Allow sufficient time for review and response.

3. Engineer will maintain log of requests for interpretation. Copy of log will be provided upon request.

4. Engineer will provide written response to each request for interpretation. One copy of Engineer's response will be distributed to:

a. Contractor

b. Owner

c. Engineer

d. Resident Project Representative (RPR)

e. Owner's Site Representative (OSR)

C. If Engineer requests additional information to make an interpretation, provide information requested within ten (10) days, unless Engineer allows additional time, via correspondence referring to request for interpretation number.

D. If Contractor or Owner believes that a change in the Contract Price or Contract Times or other change to the Contract is required, notify Engineer in writing before proceeding with the Work associated with the request for interpretation.

E. Submit each request for interpretation on a form acceptable to Engineer.

1. Number each request for interpretation as follows: Numbering system shall be the Contract number and designation followed by a hyphen and three-digit sequential number.

2. In space provided on form, describe the interpretation requested. Provide additional sheets as necessary. Include text and sketches as required in sufficient detail for engineer's response.

3. When applicable, request for interpretation shall include Contractor's recommended resolution.

1.04 CLARIFICATION NOTICES

A. General:

1. Clarification notices, when required, will be initiated and issued by Engineer.

2. Clarification notices do not change the Contract Price or Contract Times, and do not alter the Contract Documents.

3. Clarification notices will be issued as correspondence or using clarification notice form, with additional information as required.

B. Procedure:

1. One hard copy of each clarification notice will be distributed to:

a. Contractor

b. Owner

c. Engineer

d. Resident Project Representative

e. Owner's Site Representative

2. Electronic copies of Clarification Notices will be maintained, stored, and distributed by electronic construction document management system.

3. If Contractor or Owner believes that a change in the Contract Price or the Contract Times or other change to the Contract is required, notify Engineer in writing before proceeding with the Work associated with clarification notice.

4. If clarification notice is unclear, submit request for interpretation.

1.05 FIELD ORDERS

A. General:

1. Field Orders, when required, will be initiated and issued by Engineer.

2. Field Orders authorize minor variations in the Work but do not change the Contract Price or Contract Times.

3. Field Orders will be in the form of Engineers Joint Contract Documents Committee (EJCDC) document C-942, "Field Order" or other Engineer's accepted form.

4. Engineer will maintain a log of Field Orders issued.

B. Procedure.

1. One hard copy of each Field Order will be distributed to:

    a. Contractor

    b. Owner

    c. Engineer

    d. Resident Project Representative

    e. Owner's Site Representative

2. Electronic copies of Field Orders will be maintained, stored, and distributed by electronic construction document management system.

3. If Contractor or Owner believes that a change in the Contract Price or the Contract Times or other change to the Contract is required, immediately notify Engineer in writing before proceeding with the Work associated with the Field Order.

4. If the Field Order is unclear, submit request for interpretation.

1.06 WORK CHANGE DIRECTIVE

A. General:

1. Work Change Directives, when required, order additions, deletions, or revisions to the Work.

2. Work Change Directives do not change the Contract Price or Contract Times but are evidence that the parties to the Contract expect that the change ordered or documented by the Work Change Directive will be incorporated in subsequently issued Change Order following negotiations by the parties as to its effect, if any, on the Contract Price or Contract Times.

3. Work Change Directives will be in the form of EJCDC document C-940, "Work Change Directive" or other Engineer's accepted form.

B. Procedure:

1. Three originals of Work Change Directive signed by Owner and Engineer will be furnished to Contractor, who shall promptly sign each original Work Change Directive and, within five days of receipt, return all originals to Engineer.

2. Original, signed Work Change Directives will be distributed as follows:

    a. Contractor: One original

b. Owner: One original

c. Engineer: One original

3. One hard copy of each Work Change Directive will be distributed to: Resident Project Representative (RPR) or Owner's Site Representative (OSR).

4. When required by Engineer, document for the Work performed under each separate Work Change Directive, for each day, the number and type of workers employed and hours worked; equipment used including manufacturer, model, and year of equipment, and number of hours; materials used, receipts for and descriptions of materials and equipment incorporated into the Work, invoices and labor and equipment breakdowns for Subcontractors and Suppliers, and other information required by Owner or Engineer, in a format acceptable to Engineer. Submit this documentation to Engineer as a Change Proposal.

1.07 PROPOSAL REQUESTS

A. General:

1. Proposal requests may be initiated by Engineer or Owner.

2. Proposal requests are for requesting the effect on the Contract Price and the Contract Times and other information relative to contemplated changes in the Work. Proposal requests do not authorize changes or variations in the Work, and do not change the Contract Price or Contract Times or terms of the Contract.

3. Proposal requests will be furnished using the proposal request form included with this Section.

B. Procedure.

1. One copy of each signed proposal request will be furnished to Contractor with one copy each to:

a. Owner

b. Engineer

c. Resident Project Representative (RPR)

d. Owner's Site Representative (OSR)

2. Submit request for interpretation to clarify conflicts, errors, ambiguities, and discrepancies in proposal request.

3. Upon receipt of proposal request, Contractor shall prepare and submit a Change Proposal, in accordance with this Section, for the proposed Work described in the proposal request.

1.08 CHANGE PROPOSALS

A. General.

1. Submit written Change Proposal to Engineer in response to each proposal request, and when Contractor believes a change in the Contract Price or Contract Times or other change to the terms of the Contract is required.

B. Procedure.

1. Submit to Engineer one original and one copy of each Change Proposal with accompanying documentation, and simultaneously submit two copies to Owner. Submit each Change Proposal with separate letter of transmittal.

2. Engineer will review Change Proposal and either request additional information from Contractor or provide to Owner recommendation regarding approval of the Change Proposal.

3. When Engineer requests additional information to render a decision, submit required information within five days of receipt of Engineer's request, unless Engineer allows more time. Submit the required information via correspondence that refers to Change Proposal number.

4. Upon completing review, one copy of Engineer's written response, if any, will be distributed to:

   a. Contractor

   b. Owner

   c. Engineer

   d. Resident Project Representative (RPR)

   e. Owner's Site Representative (OSR)

5. If Change Proposal is recommended for approval by Engineer and approved by Owner, a Change Order will be issued.

6. If parties do not agree on terms for the change, Owner or Contractor may file a Claim against the other, in accordance with the General Conditions and the Supplementary Conditions.

C. Each Change Proposal shall be submitted on a Change Proposal form acceptable to Engineer.

1. Number each Change Proposal as follows: Numbering system shall be the Contract number and designation followed by a hyphen and three-digit sequential number. Example: First Change Proposal for the general contract for project named “Contract 23” would be, “Proposal No. 23-001”.

2. In space provided on form:

a. Describe scope of each proposed change. Include text and sketches on additional sheets as required to provide detail sufficient for Engineer’s review and response. If a change item is submitted in response to proposal request, write in as scope, “In accordance with Change Proposal Request No.” followed by the proposal request number. Provide written clarifications, if any, to scope of change.

b. Provide justification for each proposed change. If change is in response to proposal request, write in as justification, “In accordance with Change Proposal Request No.” followed by the proposal request number.

c. List the total change in the Contract Price and Contract Times for each proposed change.

3. Unless otherwise directed by Engineer, attach to the Change Proposal detailed breakdowns of pricing (Cost of the Work and Contractor’s fee) including:

a. List of Work tasks to accomplish the change.

b. For each task, labor cost breakdown including labor classification, total hours per labor classification, and hourly cost rate for each labor classification.

c. Construction equipment and machinery to be used, including manufacturer, model, and year of manufacture, and number of hours for each.

d. Detailed breakdown of materials and equipment to be incorporated into the Work, including quantities, unit costs, and total cost, with Supplier’s written quotations.

e. Breakdowns of the Cost of the Work and fee for Subcontractors, including labor, construction equipment and machinery, and materials and equipment incorporated into the Work, other costs, and Subcontractor fees.

f. Breakdown of other costs eligible, in accordance with the General Conditions and the Supplementary Conditions.

g. Other information required by Engineer.

h. Contractor's fees applied to eligible Contractor costs and eligible Subcontractor costs.

1.09 CHANGE ORDERS

A. General:

1. Change Orders will be recommended by Engineer and signed by Owner, and Contractor, to authorize additions, deletions, or revisions to the Work, or changes to the Contract Price or Contract Times.

2. Change Orders will be in the form of EJCDC document C-941, "Change Order" or other Engineer's accepted form.

B. Procedure.

1. Five originals of each Change Order will be furnished to Contractor, who shall sign each original Change Order and return all originals to Engineer within five days of receipt.

2. Engineer will sign each original Change Order and forward them to Owner.

3. Owner will sign each original Change Order and forward to the funding agency, _____.

4. After approval and signature of all parties, three executed original copies will be returned to Engineer. Engineer will distribute as follows:

a. Contractor: One original

b. Owner: One original

c. Engineer: One original

5. One copy of each Change Order will be distributed to:

a. Resident Project Representative (RPR)

b. Owner's Site Representative (OSR)

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.01 SCHEDULE

A. 2018 EJCDC Form C-942, Field Order

B. 2018 EJCDC Form C-940, Work Change Directive

C. 2018 EJCDC Form C-941, Change Order

END OF SECTION

Field Order No. _____

Date of Issuance:	Effective Date:
Owner:	Owner's Contract No.:
Contractor:	Contractor's Project No.:
Engineer:	Engineer's Project No.:
Project:	Contract Name:

Contractor is hereby directed to promptly execute this Field Order, issued in accordance with General Conditions Paragraph 9.04, for minor changes in the Work without changes in Contract Price or Contract Times. If Contractor considers that a change in Contract Price or Contract Times is required, submit a Change Proposal before proceeding with this Work.

Reference: _____ _____
Specification(s) Drawing(s) / Detail(s)

Description:

Attachments:

ISSUED:	RECEIVED:
By: _____	By: _____
Engineer (Authorized Signature)	Contractor (Authorized Signature)
Title: _____	Title: _____
Date: _____	Date: _____

Copy to: Owner

Work Change Directive No. ____

Date of Issuance:	Effective Date:
Owner:	Owner's Contract No.:
Contractor:	Contractor's Project No.:
Engineer:	Engineer's Project No.:
Project:	Contract Name:

Contractor is directed to proceed promptly with the following change(s):

Description:

Attachments: [List documents supporting change]

Purpose for Work Change Directive:
Directive to proceed promptly with the Work described herein, prior to agreeing to changes on Contract Price and Contract Time, is issued due to: [check one or both of the following]

- ☐ Non-agreement on pricing of proposed change.
- ☐ Necessity to proceed for schedule or other Project reasons.

Estimated Change in Contract Price and Contract Times (non-binding, preliminary):

Contract Price $ _____ [increase] [decrease].

Contract Time ____ days [increase] [decrease].

Basis of estimated change in Contract Price:

☐ Lump Sum ☐ Unit Price
☐ Cost of the Work ☐ Other

RECOMMENDED:	AUTHORIZED BY:	RECEIVED:
By: _____	By: _____	By: _____
Engineer (Authorized Signature)	Owner (Authorized Signature)	Contractor (Authorized Signature)
Title: _____	Title: _____	Title: _____
Date: _____	Date: _____	Date: _____

Approved by Funding Agency (if applicable)

By: _____ Date: _____

Title: _____

Change Order No. _____

Date of Issuance:	Effective Date:
Owner:	Owner's Contract No.:
Contractor:	Contractor's Project No.:
Engineer:	Engineer's Project No.:
Project:	Contract Name:

The Contract is modified as follows upon execution of this Change Order:

Description:

Attachments: [List documents supporting change]

CHANGE IN CONTRACT PRICE	CHANGE IN CONTRACT TIMES
Original Contract Price: $	[note changes in Milestones if applicable] Original Contract Times: Substantial Completion: Ready for Final Payment: days or dates
[Increase] [Decrease] from previously approved Change Orders No. to No. : $	[Increase] [Decrease] from previously approved Change Orders No. to No. : Substantial Completion: Ready for Final Payment: days
Contract Price prior to this Change Order: $	Contract Times prior to this Change Order: Substantial Completion: Ready for Final Payment: days or dates
[Increase] [Decrease] of this Change Order: $	[Increase] [Decrease] of this Change Order: Substantial Completion: Ready for Final Payment: days or dates
Contract Price incorporating this Change Order: $	Contract Times with all approved Change Orders: Substantial Completion: Ready for Final Payment: days or dates

RECOMMENDED:	ACCEPTED:	ACCEPTED:
By: _____	By: _____	By: _____
Engineer (if required)	Owner (Authorized Signature)	Contractor (Authorized Signature)
Title: _____	Title: _____	Title: _____
Date: _____	Date _____	Date: _____

Approved Funding Agency (if required)

By: _____ Date: _____

Title: _____

SECTION 01 29 73
SCHEDULE OF VALUES

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. General requirements for preliminary and final Schedule of Values.

2. Schedule of Values and the Progress Schedule updates specified in Section 01 32 00 – Construction Progress Schedule, shall be basis for preparing each Application for Payment. Schedule of Values may be used as a basis for negotiating price of changes, if any, in the Work.

1.02 ADMINSTRATIVE REQUIREMENTS

A. General Requirements:

1. Schedule of Values shall include breakdown of costs for materials and equipment, installation, and other costs used in preparing the Bid by Contractor and each Subcontractor. List purchase and delivery costs for materials and equipment for which Contractor may apply for payment as stored materials.

2. Include separate amounts for each Specification Section in the Contract Documents by structure, building, and work area.

3. Identify each line item with number corresponding to the associated Specification Section number. List sub-items of major products or systems, as appropriate or when requested by Engineer.

4. Include in Schedule of Values unit price payment items with their associated quantity. Provide in the Schedule of Values detailed breakdown of unit prices when required by Engineer.

5. Include in Schedule of Values itemized list of Work for each major part of the Contract, for each payment item specified in Section 01 20 00 – Measurement and Payment.

6. Sum of individual values shown on the Schedule of Values shall equal the total of associated payment item. Sum of payment item totals in the Schedule of Values shall equal the Contract Price.

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B. Specific Requirements:

1. Include in each line item a directly proportional amount of Contractor's overhead and profit. Do not include overhead and profit as separate item(s).

2. Include separate line item for each allowance, and for each unit price item

3. Include line item for bonds and insurance. This may be applied for in the first Application for Payment.

4. Include items for the General Conditions, permits (when applicable), construction Progress Schedule, and other items required by Engineer. Include such items in Applications for Payment on schedule accepted by Engineer

5. Line items for Site maintenance such as dust control, compliance with storm water pollution prevention plans and permits, spill prevention control and countermeasures plans, and for construction photographic documentation; temporary utilities and temporary facilities, field offices, temporary controls, field engineering, and similar Work shall be included in the Schedule of Values and proportioned in Applications for Payment throughout duration of the Work.

6. Include separate line items under each appropriate payment item for mobilization and demobilization. Document for Engineer the activities included in mobilization and demobilization line items.

C. Preliminary Schedule of Values: Submit preliminary Schedule of Values to Engineer for initial review. Contractor shall incorporate Engineer's comments into the Schedule of Values and resubmit to Engineer. Engineer may require corrections and re-submittals until Schedule of Values is acceptable.

D. Time Frame for Submittals:

1. Submit preliminary Schedule of Values within ten days of date that the Contract Times commence running in accordance with the Notice to Proceed.

2. Submittal of the Schedule of Values shall be in accordance with the General Conditions. Engineer will not accept Applications for Payment without an acceptable Schedule of Values.

3. When required by Engineer, promptly submit updated Schedule of Values to include cost breakdowns for changes in the Contract Price.

1.03 SUBMITTALS

A. Provide electronic submittals of Preliminary Schedule of Values and Final Schedule of Values

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

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SECTION 01 29 76
PROGRESS PAYMENT PROCEDURES

PART 1 – GENERAL

1.01 SUMMARY

A. Administrative and procedural requirements for progress payment to the Contractor by the Owner.

B. Related Sections:

1. Section 01 77 19 – Closeout Requirements.

1.02 ADMINSTRATIVE REQUIREMENTS

A. General: Contractor's request for payment shall be in accordance with the Agreement, General Conditions and Supplementary Conditions, and the Specifications.

B. Procedure:

1. Review with Resident Project Representative (RPR)/Owner's Site Representative (OSR) quantities and the Work proposed for inclusion in each progress payment. Application for Payment shall cover only the Work and quantities recommended by the RPR/OSR.

2. Submit to Engineer an electronic copy of the complete Application for Payment and other documents to accompany the Application for Payment.

3. Engineer will act on request for payment in accordance with the General Conditions and Supplementary Conditions.

C. Requirements:

1. Completed Application for Payment form, including summary/signature page, progress estimate sheets, and stored materials summary. Progress estimate sheets shall have the same level of detail as the Schedule of Values.

2. For materials and equipment not incorporated in the Work but suitably stored, submit documentation in accordance with the General Conditions and Supplementary Conditions. Legibly indicate on invoice or bill of sale the specific materials or equipment included in the payment request and corresponding bid/payment item number for each.

3. Contractor's Affidavit is required for payment application and requests beginning with the second application for payment.

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4. For payment requests that include payment for Work under an allowance, submit documentation acceptable to Owner of the authorization of allowance Work.

5. For payment requests (other than request for final payment) that include reduction or payment of retainage in an amount greater than that required in the Contract Documents, submit on form acceptable to Owner consent of surety to partial release or reduction of retainage.

D. Requirements for request for final payment are in the General Conditions, as modified by the Supplementary Conditions, and Section 01 77 19 – Closeout Requirements.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01 31 19
PROJECT MEETINGS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Pre-Construction Meeting:

a. Purpose of conference is to designate responsible personnel, establish working relationships, discuss preliminary schedules submitted by Contractor, and review administrative and procedural requirements for the Project. Matters requiring coordination will be discussed and procedures for handling such matters will be established.

b. Date, Time and Location: Conference will be held after execution of the Contract and before Work starts at the Site. Engineer will establish the date, time, and location of conference and notify the interested and involved parties.

2. Progress Meetings:

a. Progress meetings will be held throughout the Project. Contractor shall attend each progress meeting prepared to discuss in detail all items on the agenda.

b. Engineer will preside at progress meetings and will prepare and distribute minutes of progress meetings to all meeting participants and others as requested.

c. Date, Time and Location:

1) Regular Meetings: Every two weeks on a day and time agreeable to Owner, Engineer, and Contractor.

2) Location: The Site or other location mutually agreed upon by Owner, Contractor, and Engineer.

d. Additional meetings may be conducted as progress of Work requires at a mutually agreed date, time and location.

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1.02 ADMINSTRATIVE REQUIREMENTS

A. Pre-Construction Meeting:

1. Contractor shall provide pre-construction meeting submittals with sufficient number of copies for each attendee:

2. Required Attendees:

    a. Contractor

        1) Project manager.

        2) Site superintendent.

        3) Safety representative.

        4) Major Subcontractors.

    b. Owner.

    c. Engineer.

    d. Resident Project Representative (RPR).

    e. Owner's Site Representative (OSR).

    f. Representatives of governmental or other regulatory agencies.

3. Contractor shall prepare and submit a health and safety plan, including confined space entry plan, as specified in this Section prior to the pre-construction meeting.

4. Agenda, minimum:

    a. Procedural requirements:

        1) Designation of responsible personnel

        2) Use of Site and Owner's requirements, including general regards for community relations

        3) Delivery of materials and equipment to the Site

        4) Safety and first aid procedures

        5) Confined space entry plan

        6) Security procedures

        7) Housekeeping procedures

    b. Administrative requirements:

1) Distribution of Contract Documents.

2) Shop Drawing submittal procedures.

3) Maintaining record documents at the Site.

4) Contract modification procedures

5) Processing of Payment Application

c. Site mobilization requirements:

1) Working hours, overtime, and holidays.

2) Field offices, trailers, and staging areas.

3) Temporary facilities and utilities, including usage and coordination.

4) Temporary controls, such as sediment and erosion control, noise, dust, storm water, and other measures.

5) Access to Site, access roads, and parking for construction vehicles.

6) Protection of traffic and existing property, including site barriers and temporary fencing.

7) Security

8) Storage of materials and equipment.

9) Reference points and benchmarks, surveys and layouts.

10) Site maintenance during the project, including cleaning and removal of trash and debris.

11) Site restoration.

d. Schedules

1) Preliminary construction schedule

2) Critical work sequencing

3) Preliminary Shop Drawing submittal schedule

4) Preliminary Schedule of Values

B. Progress Meetings:

1. Progress meetings frequency shall be conducted as specified in this Section, unless modified and agreed upon by Owner, Contractor, and Engineer. Additional meetings may be conducted as progress of Work requires.

2. Contractor shall provide submittals specified in this Section prior to each progress meeting.

3. Attendance:

    a. Contractor, including project manager, site superintendent, safety representative, and representatives of Subcontractors and Suppliers as required.

    b. Engineer, including project manager (or designated representative), Resident Project Representative (if any), others as required by Engineer.

    c. Owner, including Owner's Site Representative (if any).

    d. Subcontractors, only with Engineer's approval or request, as required in the agenda.

4. Agenda, minimum:

    a. Review, comment, and amendment (if required) of minutes of previous progress meeting.

    b. Review of progress since the previous progress meeting.

    c. Planned progress through next 30 – 60 days.

    d. Review of Progress Schedule

        1) Contract Times, including Milestones (if any)

        2) Critical path.

        3) Schedules for fabrication and delivery of materials and equipment.

        4) Corrective measures, if required.

    e. Submittals:

        1) Review of status of critical submittals.

        2) Review revisions to schedule of submittals.

    f. Contract Modifications:

1) Requests for interpretation

2) Clarification notices

3) Field Orders

4) Proposal requests

5) Change Proposals

6) Work Change Directives.

7) Change Orders.

8) Claims.

g. Applications for progress payments.

h. Problems, conflicts, and observations.

i. Quality standards, testing, and inspections.

j. Coordination between parties.

k. Site management issues, including access, security, maintenance and protection of traffic, maintenance, cleaning, and other Site issues.

l. Safety.

m. Permits.

n. Record documents status.

o. Punch list status, as applicable.

p. Other business.

1.03 SUBMITTALS

A. Pre-Construction Meeting Submittals:

1. Prior to the conference, submit the following preliminary schedules in accordance with the General Conditions:

1) Progress schedule

2) Schedule of submittals

3) Schedule of values

2. Contractor's safety and first aid procedures.

3. Confined space entry plan.

4. List of emergency contact information

B. Progress Meeting Submittals:

1. List of Work accomplished since the previous progress meeting.

2. Up-to-date Progress Schedule.

3. Up-to-date Schedule of Submittals.

4. Detailed "look-ahead" schedule of Work planned through the next progress meeting, with specific starting and ending dates for each activity, including shutdowns, deliveries of important materials and equipment, Milestones (if any), and important activities affecting the Owner, Project, and Site.

5. When applicable, list of upcoming, planned time off (with dates) for personnel with significant roles on the Project, and the designated contact person in their absence.

1.04 EMERGENCY CONTACT INFORMATION

A. Contractor shall provide list of emergency contact information for 24-hour use throughout the Project. Emergency contact information shall be updated and kept current throughout the Project. If personnel or contact information change, provide updated emergency contact information list at the next progress meeting.

B. Contractor's list of emergency contact information shall include:

1. Contractor's project manager's office, field office, cellular, and home telephone numbers.

2. Contractor's Site superintendent's office, field office, cellular, and home telephone numbers.

3. Contractor's foreman's field office, cellular (if available), and home telephone numbers.

4. Major Subcontractors' and Suppliers' office, cellular, and home telephone numbers of project manager and foreman (when applicable).

C. Additional Emergency Contact Information:

1. Owner’s Project Manager: office, cellular, and home telephone numbers.

2. Owner’s central 24-hour emergency telephone number.

3. Engineer’s project engineer’s office, cellular, and home telephone numbers.

4. Resident Project Representative’s office, field office, cellular, and home telephone numbers.

5. Owner’s Site Representative’s office, field office, cellular, and home telephone numbers.

6. Emergency telephone numbers, including: “Emergency: Dial 911”, and seven-digit telephone numbers for the hospital, ambulance, police, and fire department nearest to the Site. Provide names of each of these institutions.

7. Other involved entities as applicable.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

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SECTION 01 32 00
CONSTRUCTION PROGRESS SCHEDULE

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes: Detailed requirements and/or procedures for, including but not limited to, the Preliminary Project Schedule, Project Schedule Updates, Project Schedule development, Time Impact Analysis, and Recovery Schedules

B. The Contractor shall develop, revise, and provide all information and input required for the Project Schedule for the performance of the Work in accordance with the requirements of the Contract Documents in general and, in particular, this section. The Progress Schedule shall incorporate the requirements of General Conditions, Supplementary Conditions, and all items specified in this section.

C. Except as otherwise provided herein or elsewhere in the Contract Documents, the planning, scheduling, coordination, and execution of the Work is the sole responsibility of the Contractor.

1.02 REFERENCES

A. Definitions:

1. Activity: An element of the construction work that has the following specific characteristics: consumes time, consumes resources, has a definable start and finish, is assignable, and is measurable.

2. Constraint: An imposed date on the Progress Schedule or an imposed tie between Activities. The Contract Times are Constraints.

3. CPM Progress Schedule: Computerized Progress Schedule in Critical Path Method (CPM) format which accounts for the entire Work, defines the interrelationships between elements of the Work, reflects the uncompleted Work, and indicates the sequence with which the Work has been completed, indicates the sequence in which uncompleted Work will be completed, and indicates the duration of each Activity.

4. Critical Path: The continuous chain of Activities with the longest duration for completion within the Contract Times.

5. Early Start: The earliest possible date an Activity can start according to the assigned relationships among Activities.

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6. Early Finish: The earliest possible date an Activity can finish according to the assigned relationships among the Activities.

7. Late Finish: The latest possible date an Activity can finish without extending the Contract Times.

8. Late Start: The latest possible date an Activity can start without extending the Contract Times.

9. Total Float: The total number of days that an Activity (or chain of Activities) can be delayed without affecting the Contract Times. Total float for each Activity shall be calculated as the difference between Early Finish and Late Finish.

10. Network Diagram: A time-scaled logic diagram depicting the durations and relationships of the Activities.

11. Work Areas, Area, or System: A logical breakdown of the Project elements or a group of Activities which, when collectively assembled, are readily identifiable on the Project (for example, yard piping, a structure or building, a treatment process, or other logical grouping).

1.03 ADMINSTRATIVE REQUIREMENTS

A. Initial Progress Schedule:

1. Type and Organization of Progress Schedules:

a. Prepare one Progress Schedule covering the entire Project using Primavera Planner (P6 or newer), or Microsoft Project scheduling software.

b. Schedule submittals shall include the electronic native file format (i.e., scheduling software file), and a PDF file of the schedule's logic diagram.

c. Time Scale: Indicate first date of each work week.

d. Activity Designations: Indicate ~~title~~ concise description of the Work represented by the activity and related Specification Section number. The Work related to each activity shall be limited to one work trade and one construction area.

2. Submitted PDF files shall be in a Gantt Chart Format and shall show the following:

a. Activity identification number.

b. Activity description.

c. Activity duration (in workdays).

d. Activity percent complete

e. Start, Early Start, Late Start, Finish, Early Finish, and Late Finish Dates

f. Total Float for each Activity.

g. Critical Path denoted.

3. Organization:

    a. Group shop drawings, samples and other submittals into a separate sub-schedule that is part of the Progress Schedule.

    b. Group deliveries of materials and equipment into a separate sub-schedule that is part of the Progress Schedule.

    c. Group construction into Work Area sub-schedules (that are part of the Progress Schedule) by Activity.

    d. Clearly indicate the Critical Path on the Progress Schedule.

    e. Organize each Work Area sub-schedule by Specification Section number.

4. Preliminary Progress Schedule:

    a. Contractor shall submit to Engineer the Preliminary Progress Schedule within ten (10) days after the Contract Times commence running.

5. Initial Acceptance of Progress Schedule:

    a. At least 10 days before submission of the first Application for Payment, Contractor shall schedule a conference at the Site for review of the Preliminary Progress Schedule.

        1) Attendees shall include Contractor, Engineer, Owner, and others as required.

        2) Contractor shall have an additional 10 days to make corrections and adjustments and to complete and resubmit the Progress Schedule.

        3) Owner reserves the right to not make progress payment to Contractor until acceptable Progress Schedule, and other reports and schedule-related documents required are submitted to Engineer.

b. Initially-accepted Progress Schedule shall be identified as the Baseline Progress Schedule. The Baseline Progress Schedule shall not be revised without Owner and Engineer approval.

B. Project Schedule Updates:

1. Project Schedule Updates shall be prepared on a monthly basis throughout the entire Contract Time and until Project Final Completion. The Engineer will not recommend progress payments by the Owner until a complete Project Schedule Update (including Schedule Narrative Report) is received, reviewed, and accepted by the Engineer.

2. The update to the Progress Schedule shall be based on retained logic. Progress override logic is not allowed.

3. Required scheduling software, and schedule organization, format, and content for updated Progress Schedules are identical to that required in this Section for initial Progress Schedules.

4. For all Project Schedule Updates, the percent complete reported for individual Activities shall be based on Work accepted and paid for the by Owner in monthly pay applications. Failure to comply with this requirement shall be result in rejection of the submitted update. Rejection of the Project Schedule Update will in turn result in the Engineer not recommending progress payments by the Owner.

5. Monthly Progress Schedule Updates shall be accompanied by a Schedule Narrative Report. The report shall:

a. Describe Work completed within the preceding month.

b. Describe Work planned for the following month (including a look-ahead schedule).

c. Identify proposed changes or revisions to the Baseline Progress Schedule.

d. Identify all Work performed out of sequence.

e. Identify problem areas.

f. Identify current or anticipated conditions which may delay the Work.

1.04 PROJECT SCHEDULE DEVELOPMENT

A. The schedule shall cover the entire Contact Time, and the Work shall be scheduled to complete the Project within the Contract Time.

B. The Schedule’s Late Finish Date shall equal the Contract Completion Date.

C. All activities except for the NTP and Final Completion shall have a predecessor and a successor. No open-ended activities will be permitted. Note that NTP shall have a successor or successors and Final Completion shall have a predecessor or predecessors.

D. Proposed durations assigned to each activity shall be the Contractor's best estimate of time required to complete the activity, considering the scope and resources planned for the activity.

E. The durations of activities shall be expressed in whole working days, with a maximum duration of 20 workdays each, unless otherwise approved or directed by the Engineer or the Owner. The duration of non-construction activities including mobilization, shop drawings and sample submittals, fabrication of materials and equipment, and delivery of materials and equipment may exceed this limitation.

F. The Schedule shall incorporate in detail all elements of the Work contained within the Contract Documents. Specific elements of the Work to incorporate into the schedule include but are not limited to the following:

1. Notice to Proceed.

2. Mobilization and demobilization.

3. Submittals including O&M Manuals. Note that durations for Engineer review time shall be 30 working days unless specified elsewhere in these Contract Documents.

4. Fabrication and procurement activities.

5. Temporary construction activities and relocations

6. Permitting

7. Erosion control

8. Site clearing

9. Site restoration

10. All requirements for coordination with Owner operations

11. Concrete curing and form removal

12. All testing activities

13. Inspections as required by local authorities.

14. Interim Milestones as defined by this Contact or as deemed critical as the project progresses.

15. All requirements related to facility startup and commissioning.

16. Substantial Completion (including the period for performing the punchlist)

17. Final Completion

1.05 TIME IMPACT ANALYSIS

A. General:

1. Prepare and submit a time impact analysis when one or more of the following occurs:

    a. Change Order proposal is prepared.

    b. Work Change Directive is issued that will affect the Progress Schedule.

    c. When delays are experienced.

2. Time impact analysis shall illustrate the influence of each Change Order, Work Change Directive, or delay.

3. Each time impact analysis shall include a sketch (fragnet) demonstrating how Contractor proposes to incorporate the changes in the Project or, as applicable, delays into the Progress Schedule. Fragnet shall include all logic, and additions required as result of said Change Order, Work Change Directive, or delay.

4. Fragnet shall show all CPM logic revisions for the Work associated with the Change Order, Work Change Directive, or delay and its relationship to other Activities.

5. Timing of Time Impact Analysis:

    a. Submit each time impact analysis within 7 days after the following, as applicable:

        1) Start of the delay.

        2) After the submittal of Change Order proposal to Engineer

        3) After Contractor’s Receipt of Work Change Directive.

    b. Failure to Submit Time Impact Analysis: When General Contractor does not submit time impact analysis for a specific change or delay under the General Contract, within the specified period of time for such submittal, such non-

submittal shall be construed that no extension of the Contract Times is required

B. Evaluation by Engineer and Acceptance:

1. Engineer's evaluation of each time impact analysis comprised of complete information will be completed in timely manner after Engineer's receipt. Changes in the Contract Times will be made only by Change Order.

2. When mutual agreement is reached between the parties, on effect of the change or delay in the Project, incorporate into the next Progress Schedule and update the associated fragnets illustrating the influence of changes and delays.

1.06 RECOVERY SCHEDULES

A. General:

1. When updated Progress Schedule indicates that the ability to comply with the Contract Times falls 30 or more days behind schedule, and there is no excusable delay, Change Order, or Work Change Directive to support an extension of the Contract Times, Contractor shall prepare and submit a Progress Schedule demonstrating Contractor's plan to accelerate the Project to achieve compliance with the Contract Times (i.e., "recovery schedule") for Engineer's acceptance.

2. Submit recovery schedule within 14 days after submittal of updated Progress Schedule where need for recovery schedule is indicated.

B. Implementation of Recovery Schedule:

1. At no additional cost to Owner, Contractor shall do one or more of the following:

a. Furnish additional labor and construction equipment.

b. Employ additional work shifts.

c. Expedite procurement of materials and equipment to be incorporated into the Work.

d. Other measures necessary to complete the Work within the Contract Times.

2. Upon acceptance of recovery schedule by Engineer, incorporate recovery schedule into the next Progress Schedule update.

C. Lack of Action: Contractor's refusal, failure or neglect to submit a recovery schedule, shall constitute reasonable evidence that Contractor is not prosecuting the Work or separable part thereof with the diligence that will ensure completion within the Contract

Times. Such lack of action shall constitute sufficient basis for Owner to exercise remedies available to Owner under the Contract Documents

1.07 USE OF FLOAT

A. Total Float and Contract Float belong to the Project and may be used by Owner, Engineer, or Contractor to accommodate modifications, regardless of origination, in the Work or to mitigate the effect of events that may delay performance or completion of the Work.

B. Changes or delays that influence scheduled Work Activities with Float and that do not extend the critical path will not be justification for an extension in Contract Times.

1.08 SUBMITTALS

A. Action/Informational Submittals:

1. Initial Progress Schedules:

a. Preliminary Progress Schedule

b. Acceptable Progress Schedule (Baseline)

2. Progress Schedule Updates:

a. Progress Schedule updates shall comply with requirements of this Section and shall include updated Progress Schedule and Schedule Narrative Report.

b. Submit updated Progress Schedule at each progress meeting. If a Progress Schedule remains unchanged from one progress meeting to the next, submit a written statement to that effect.

3. Time Impact Analyses: Submit in accordance with this Section.

4. Recovery Schedule: Submit in accordance with this Section.

5. Qualifications: Progress Schedule preparer, and other personnel that will assist Progress Schedule preparer in preparing and maintaining the Progress Schedule.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

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SECTION 01 33 00
SUBMITTAL PROCEDURES

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes:

1. Contractor shall provide submittals in accordance with the General Conditions as modified by the Supplementary Conditions, and this Section.

2. Contractor is responsible to confirm and correct dimensions at the Site, for information pertaining to the fabrication processes and to techniques of construction, and for coordinating the work of all trades. Contractor's signature of submittal's stamp and letter of transmittal shall be Contractor's representation that Contractor has met their obligations under the Contract Documents relative to that submittal.

B. Related Sections:

1. Section 01 25 00 – Substitution Procedures.

2. Section 01 78 23 – Operation and Maintenance Data.

3. Section 01 78 39 – Project Record Documents.

4. Section 01 78 43 – Spare Parts and Extra Material.

5. Section 01 79 00 – Instruction of Owner's Personnel.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Types of Submittals: When type of submittal is not specified and is not specified in this Section, Engineer will determine type of submittal.

1. Action/Informational Submittals:

a. Shop Drawings

b. Product data

c. Delegated design submittals in accordance with the General Conditions and as modified by the Supplemental Conditions

d. Samples

e. Testing plans, procedures, and testing limitations

f. Design data not sealed and signed by a design professional retained by Contractor, Subcontractor, or Supplier

g. Pre-construction test and evaluation reports, such as reports on pilot testing, subsurface investigations, potential Hazardous Environmental Conditions, and similar reports

h. Supplier instructions, including installation data, and instructions for handling, starting-up, and troubleshooting

i. Sustainable design submittals (other than sustainable design closeout documentation)

j. Lesson plans for training and instruction of Owner's personnel

k. Contractor daily reports

l. Certificate of compliance

m. Product samples

n. Elevation Certificates for new structures (signed and sealed by a Professional Surveyor registered in the State of Florida)

o. Elevation Certificates for existing structures that have been modified and/or equipment replaced (signed and sealed by a Professional Surveyor registered in the State of Florida)

2. Closeout Submittals:

a. Maintenance contracts.

b. Operations and maintenance data.

c. Bonds, such as maintenance bonds and bonds for a specific product or system.

d. Warranty documentation.

e. Record documentation.

f. Sustainable design closeout documentation.

g. Software.

3. Maintenance Material Submittals:

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a. Maintenance materials schedule and checklist.

b. Spare parts.

c. Extra stock materials.

d. Tools.

4. Quality Assurance Submittals:

a. Performance affidavits.

b. Certificates.

c. Source quality control submittals (other than testing plans, procedures, and testing limitations), including results of shop testing.

d. Field or Site quality control submittals (other than testing plans, procedures, and testing limitations), including results of operating and acceptability tests at the Site.

e. Supplier reports.

f. Special procedure submittals, including health and safety plans and other procedural submittals.

g. Qualifications statements.

B. Submittal Requirements:

1. Contractor shall submit electronic copy of submittals for Engineer's review via Procore Document Management unless otherwise specified in individual Specification Sections. Acceptable electronic formats are PDF Unless otherwise specified.

2. Submittals shall be furnished in two dimensional PDF three dimensional Revit file format and accompanied by two dimensional PDF format.

3. Submittal shall be accompanied by letter of transmittal containing date, project title, Contractor's name, number and title of submittal, list of relevant Specification Sections, notification of deviations from Contract Documents, and other material required for Engineer's review.

4. Submittals with internet hyperlinks and other references to online content shall not be considered, reviewed, and included as part of the submittal review procedure. Hyperlinks and other electronic references shall not be used to comply with

specified requirements of the Contract Documents, unless specifically stated in the individual technical Specification Section.

C. Scheduling:

1. Provide submittals well in advance of the Work following Engineer's approval or acceptance of the associated submittal. Work covered by a submittal will not be included in progress payments until approval or acceptance of related submittals has been obtained in accordance with the Contract Documents.

2. Submittals shall be provided by Contractor with at least twenty-one (21) working days for review and processing.

1.03 SCHEDULE OF SUBMITTALS

A. Schedule of Submittals, as specified in this Section:

1. Timing:

a. Provide submittal within time frames specified in the Contract Documents.

b. Provide updated Schedule of Submittals with each submittal of the updated Progress Schedule.

2. Content: In accordance with the General Conditions as modified by the Supplementary Conditions, and this Section. Requirements for content of preliminary Schedule of Submittals and subsequent submittals of the Schedule of Submittals are identical.

a. Identify submittals required in the Contract Documents. Updates of Schedule of Submittals shall show scheduled dates and actual dates for completed tasks. Indicate submittals that are on the Project's critical path.

b. Indicate the following for each submittal:

1) Date when submittals are requested and received from Supplier.

2) Date when certification is received from Supplier and when submitted to Engineer.

3) Date when submittals are submitted to Engineer and returned with disposition from Engineer.

4) Date when submittals are revised by Supplier and submitted to Engineer.

5) Date when submittals are returned with “Furnish as Submitted” (FAS) or “Furnish as Corrected” (FAC) disposition from Engineer.

6) Date when approved submittals are returned to Supplier.

7) Date of Supplier scheduled delivery of equipment and material.

8) Date of actual delivery of equipment and material.

9) Whether submittal will be for a substitution or “equal”. Procedures for substitutions and “or equals” are specified in the General Conditions and the Section 01 25 00 – Substitution Procedures.

10) For submittals for materials or equipment, date by which material or equipment must be at the Site to avoid delaying the Work and to avoid delaying the work of other contractors.

3. Prepare Schedule of Submittals using same software, and in same format, specified for Progress Schedules.

4. Coordinate Schedule of Submittals with the Progress Schedule.

5. Schedule of Submittals that is not compatible with the Progress Schedule, or that does not indicate submittals on the Project’s critical path, or that places extraordinary demands on Engineer for time and resources, is unacceptable. Do not include submittals not required by the Contract Documents.

6. In preparing Schedule of Submittals:

a. Considering the nature and complexity of each submittal, allow sufficient time for review and revision.

b. Reasonable time shall be allowed for: Engineer’s review and processing of submittals, for submittals to be revised and resubmitted, and for returning submittals to Contractor.

c. Identify and accordingly schedule submittals that are expected to have long anticipated review times.

1.04 ACTION/INFORMATIONAL SUBMITTALS

A. Provide the following Submittals in accordance with the individual Specification Sections, including, but not limited to, the following:

1. Product Data:

a. Catalog cut-sheets

b. Descriptive bulletins/brochures/specifications

c. Material of construction data, including details on all components including applicable ASTM designations.

d. Lifting, erection, installation, and adjustment instructions, and recommendations

e. Finish/treatment data, including interior and exterior shop coating systems

f. Equipment/material weight/loading data, including total uncrated weight of the equipment plus the approximate weight of shipped materials. Support locations and loads that will be transmitted to bases and foundations following installation. Size, placement, and embedment requirements of anchor bolts.

g. Complete information regarding location, type, size, and length of all field welds in accordance with "Standard Welding Symbols" AWS A2.0 of the American Welding Society. Special conditions shall be fully explained by notes and details.

h. Motor data including horsepower; enclosure type; voltage; insulation class; temperature rise and results of dielectric tests; service-rating; rotative speed; motor speed-torque relationship; efficiency and power factor at ½, ¾, and full load; slip at full load; running, full load, and locked rotor current values; safe running time-current curves; motor protective devices; and interconnection diagrams.

i. Engineering design data, calculations, and system analyses

j. Digital system documentation

k. Operating sequence descriptions

l. Software/programming documentation

m. Manufacturer’s instructions

2. Shop Drawings:

a. Equipment and material layout drawings, including panel layout drawings.

b. System schematics and diagrams including, but not limited to, piping systems; HVAC and ventilation systems; process equipment systems; electrical operating systems; wiring diagrams; controls, alarm and communication systems.

c. Layout and installation drawings (interior and exterior) for all pipes, valves, fittings, sewers, drains, heating and ventilation ducts, all electrical, heating, ventilating and other conduits, plumbing lines, electrical cable trays, lighting fixture layouts, and circuiting, instrumentation, interconnection wiring diagrams, communications, power supply, alarm circuits, etc.

d. Layout and installation drawings shall show connections to structures, equipment, sleeves, valves, fittings, etc.

e. Drawings shall show the location and type of all supports, hangers, foundations, etc., and the required clearances to operate valves, equipment, etc.

f. Drawings for pipes, ducts, conduits, etc., shall show all 3 inch and larger electrical conduits and pressure piping, electrical cable trays, heating and ventilation ducts or pipes, structure, manholes or any other feature within four (4) feet (measured as the clear dimension) from the pipe duct, conduit, etc., for which the profile is drawn.

g. Equipment and material schedules.

3. Delegated design submittals, which include documents prepared, sealed, and signed by a design professional retained by Contractor, Subcontractor, or Supplier for materials and equipment to be incorporated into the completed Work. Delegated design submittals do not include submittals related to temporary construction unless specified otherwise in the related Specification Section. Delegated design submittals include: design drawings, design data including calculations, specifications, certifications, and other submittals prepared by such design professional.

B. Samples:

1. General Requirements:

a. Conform submittal of Samples to the General Conditions as modified by the Supplementary Conditions, this Section, and the Specification Section in which the Sample is specified.

b. Furnish at the same time Samples and submittals that are related to the same unit of Work or Specification Section. Engineer will not review submittals without associated Samples and will not review Samples without associated submittals.

c. Samples shall clearly illustrate functional characteristics of product, all related parts and attachments, and full range of color, texture, pattern, and material.

2. Submittal Requirements:

    a. Securely label or tag Samples with submittal identification number. Label or tag shall not cover, conceal, or alter appearance or features of Sample. Label or tag shall not be separated from the Sample.

    b. Submit number of Samples required in Specifications. If number of Samples is not specified in the associated Specification Section, provide at least one identical Samples of each item required for Engineer's approval. If Contractor requires Sample(s) for Contractor's use, notify Engineer in writing and provide additional Sample(s). Contractor is responsible for furnishing, shipping, and transporting additional Samples.

    c. Deliver one Sample to Engineer's field office at the Site. Deliver balance of Samples to location directed by Engineer.

C. Contractor Daily Reports:

1. The Contractor shall complete a daily report indicating manpower, equipment, subcontractors present, work completed, and weather conditions. The daily report shall be completed on forms approved by the Engineer and shall be submitted electronically to the Engineer on a weekly basis.

D. Elevation Certificates

1. FEMA Form FF-206-FY-22-152 shall be completed by the Contractor and submitted to the City of Fort Lauderdale Development Services for each applicable structure. Applicable structures include electrical buildings, transformer pads, generator pads, fuel storage tank pads, electrical equipment pads, and any other structure as determined by the City's Development Services Department.

2. Certificates shall be signed and sealed by a Professional Land Surveyor.

3. A copy of each completed certificate shall be provided to the Engineer and to the City.

4. Elevation Certificates shall be submitted to Development Services within 14 days of completing final structural work for foundation slabs, pads, or structures but prior to installation of mechanical or electrical equipment.

1.05 CLOSEOUT SUBMITTALS

A. Provide the following Closeout Submittals in accordance with the individual Specification Sections, including, but not limited to, the following:

1. Maintenance contracts

2. Bonds for specific products or systems

3. Warranty documentation

4. Sustainable design closeout documentation.

5. Software programming and documentation.

B. On documents such as maintenance contracts and bonds, include on each document furnished original signature of entity issuing the document.

C. Operations and Maintenance Data: Submit in accordance with Section 01 78 23 – Operations and Maintenance Data.

D. Record Documentation: Submit in accordance with Section 01 78 39 – Project Record Documents.

E. Disposition: Dispositions and meanings are the same as specified for Informational Submittals.

1.06 MAINTENANCE MATERIAL SUBMITTALS

A. For spare parts, extra stock materials, and tools, submit quantity of items specified in associated Specification Section. Furnish in accordance with Section 01 78 43 – Spare Parts and Extra Materials.

B. Disposition: Dispositions and meanings are the same as specified for Informational Submittals.

1.07 CONTRACTOR'S RESPONSIBILITIES

A. Contractor shall review, coordinate, and verify submittals with Subcontractors, Manufacturers, and Suppliers, including field measurements at Site, in accordance with the General Conditions and as modified by Supplemental Conditions prior to submitting material for Engineer's review.

B. Contractor shall clearly and concisely indicate and mark equipment and material being submitted to meet the intent of the Contract Documents. Equipment and material not being submitted shall be deleted, stricken through, or otherwise designated not being submitted. Equipment and material data sheets shall be included once with cross references throughout the submittal. Multiple equipment and material data sheets for the same item within a submittal may receive a rejected disposition until corrected.

1. Individual Specification Sections require a Compliance, Deviations, and Exceptions (CD&E) letter to be included with the submittal. When specified, submittals provided without the CD&E letter shall receive a rejected disposition without review.

2. CD&E letter requirements:

    a. Include a copy of entire Specification section with each paragraph and subparagraph noted with “C”, “D”, or “E” to indicate if equipment and material being provided is in compliance (C), deviates (D), or exceptions (E) are taken with the Contract Documents.

        1) Compliance (C): Full compliance with the specified requirement.

        2) Deviation (D): Deviation from the specified requirement.

        3) Exception (E): Exception with the specified requirement.

    b. Include all comments, deviations and exceptions taken to the Contract Documents by the Contractor and Equipment Manufacturer/Supplier.

    c. Any requirements with the letter "D" or "E" beside them shall be provided with a full typewritten explanation of the deviation/exception. Handwritten explanation of the deviations/exceptions is not acceptable.

    d. Address deviations and exceptions taken to each Contract Drawing related to the Specification section.

C. Contractor shall provide Contractor’s stamp of approval certifying submittal material has been reviewed and conform to the Contract Documents prior to submitting material for Engineer’s review.

D. Contractor shall provide written notice of deviations or variations that submittal may have with the Contract Documents.

E. Contractor shall provide bound, dated, labeled, tabulated, and consecutively numbered submittals as specified in the individual Specification Section. Label shall contain the following:

    1. Specification Section.

    2. Referenced Drawing number.

    3. Subcontractor or Supplier name.

    4. Type of equipment and/or materials.

F. Contractor shall perform the following after receiving Engineer’s review disposition:

    1. Order, fabricate, or ship equipment and materials included in the submittal (pending Engineer’s review of source quality control submittals) with the following disposition:

a. “Furnish as Submitted” (FAS).

b. “Furnish as Corrected” (FAC).

c. “Furnish as Corrected – Confirm” (FACC), only portions of Work that do not require resubmittal for Engineer’s review.

2. Resubmittal requirements:

a. Partial resubmittal of “Furnish as Corrected – Confirm” (FACC) returned dispositions, until Engineer’s disposition is either “Furnish as Submitted” (FAS) or “Furnish as Corrected” (FAC).

b. Full resubmittal of material with Engineer’s disposition of “Revise and Resubmit” (R&R), until Engineer’s disposition is “Furnish as Submitted” (FAS), “Furnish as Corrected” (FAC), or “Furnish as Corrected – Confirm” (FACC) that requires a partial resubmittal.

c. Contractor shall be responsible for Engineer’s charges to Owner if submittals are not approved within the number of specified submittals in accordance with the General Conditions. Engineer’s charges shall include, but not limited to, additional review effort, meetings, and conference calls with Contractor, Subcontractor, or Supplier.

1.08 ENGINEER’S REVIEW

A. Engineer’s review of the Contractor’s submittal shall not relieve Contractor’s responsibility under the Contract Document in accordance with the General Conditions and as modified in the Supplemental Conditions. An acceptance of a submittal shall be intended to mean the Engineer does not have specific objection to the submitted material, subject to conformance with the Contract Drawings and Specifications.

B. Engineer’s review of Contractor’s submittal shall be confined to general arrangement and compliance with the Contract Documents, and shall not be for the purpose of checking dimensions, weights, clearances, fittings, tolerances, interferences, coordination of Subcontractor work, etc.

C. Review Dispositions:

1. “Furnish as Submitted” (FAS) – No exceptions are taken.

2. “Furnish as Corrected” (FAC) – Minor corrections are noted for Contractor’s correction.

3. “Furnish as Corrected – Confirm” (FACC) – Corrections are noted and partial resubmittal shall be made as noted.

4. “Revise and Resubmit” (R&R) – Corrections are noted and complete resubmittal shall be made. Submittal does not conform to applicable requirements of the Contract Documents and is not acceptable. Revise submittal and re-submit to indicate acceptability and conformance with the Contract Documents.

5. “Receipt Acknowledged” (RA) –

    a. Information included in submittal conforms to the applicable requirements of the Contract Documents and is acceptable. No further action by Contractor is required relative to this submittal, and the Work covered by the submittal may proceed, and products with submittals with this disposition may be shipped or operated, as applicable.

    b. Information included in submittal is for Project record purposes and does not require Engineer’s review or approval.

6. “Rejected” (R) – Information included in submittal does not conform to the applicable requirements of the Contract Documents and is unacceptable. Contractor shall submit products and materials as specified in the Contract Documents or provide required information for substitution as specified in the Contract Documents for consideration by Engineer.

D. Electronic Submittal Return to Contractor: Electronic submittals shall be returned electronically with dispositions provided.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01 35 20
CONFINED SPACE ENTRY PLAN

PART 1 – GENERAL

1.01 SUMMARY

A. Owner has determined that portions of the Site may constitute confined spaces or permit-required confined spaces, as defined in this Section.

B. Contractor shall provide appropriate measures, including labor, supervision, equipment, protective devices, and incidentals, to protect the health and safety of personnel at the Site relative to confined spaces, and who may be affected by the Work in confined spaces including, without limitation: employees and agents of Contractor, Subcontractors, Suppliers, Owner, and Engineer, while engaged in performance of their respective duties at Site.

C. Comply with requirements of Owner's confined space entry program, if any.

1.02 REFERENCES

A. Definitions: The following words or terms are not defined but, when used in this Section, have the following meaning:

1. "Confined spaces" are areas on or about the Site as defined in 29 CFR 1910.146(b) and 29 CFR 1926.1202. Confined spaces include, but are not limited to: storage tanks, process vessels, bins, boilers and similar spaces; ventilation or exhaust ducts and stacks; manholes, underground utility vaults and chambers, sewers, pipelines, tunnels; and open-topped spaces greater than four feet deep, such as pits, tubs, vaults, and vessels.

2. "Entry permit" means the written or printed document provided by the employer of personnel entering permit-required confined space, to allow and control entry into permit-required confined space and that contains the information specified in 29 CFR 1910.146(f) and 29 CFR 1926.1206.

3. "Permit-required confined space" means confined space as defined in 29 CFR 1926.146(b) and 29 CFR 1926.1202 and that has one or more of the following characteristics:

a. Contains or has potential to contain a hazardous atmosphere.

b. Contains material that has potential for engulfing an entrant.

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c. Has internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or floors, or by floor that slopes downward and tapers to a smaller cross-section.

d. Contains other recognized serious safety or health hazard.

4. “Hot work permit” means the written authorization of employer of personnel entering a confined space to perform operations, such as riveting, welding, cutting, burning, and heating, capable of providing a source of ignition.

5. “Host Employer” means the employer that owns or manages the property where construction is taking place.

6. “Controlling Contractor” is the employer that has overall responsibility for construction at the worksite.

B. Reference Standards: Comply with Laws and Regulations related to protecting personnel working in or entering confined spaces, including:

1. Code of Federal Regulations (CFR), Title 29, Part 1910, Occupational Safety and Health Standards.

2. CFR, Title 29, Part 1926, Safety and Health Regulations for Construction.

1.03 PLAN REQUIREMENTS

A. Review host employer’s existing confined space inventory and entry procedures, if available, in order to prepare Site- and task-specific confined space entry plans which shall be incorporated into Contractor’s Site-specific health and safety plan. Maintain copy of the confined space entry plan at the Site for access by employees, Owner and authorities having jurisdiction. Confined space entry plan shall include:

1. Results of Contractor’s Site-specific hazard assessment to identify confined spaces that are permit-required confined spaces, including list of all such spaces that will be accessed for the Work. Update the list as required throughout the Project.

2. Requirements for safeguarding access to, and restricting non-permitted personnel from access to, permit-required confined spaces during the Work.

3. Project-specific procedures to be followed when entering or accessing permit-required confined spaces.

4. Documentation of training provided to each person that will enter, or work in conjunction with entry to, permit-required confined spaces

5. Update the plan by adding copies of permits issued and records of entry to permit-required confined spaces, as required in this Section.

B. Confined Space Safety:

1. Personnel entering confined space shall be trained in accordance with 29 CFR 1926.1207and 29 CFR 1910.146(g).

2. Comply with 29 CFR 1926 Subpart AA and requirements of authorities having jurisdiction.

3. Recordkeeping: Using forms required by Contractor, Owner, or authority having jurisdiction, issue for each instance of access to permit-required confined space, completed permit(s) and complete associated data sheet. File completed permits and data sheets in the Site-specific confined space entry plan and submit in accordance with this Section.

a. Permit for entry to permit-required confined space(s).

b. Permit for hot work in permit-required confined space(s).

c. Complete confined space data sheet.

1.04 SUBMITTALS

A. If acceptable, written response for Submittals required in this Section will not be returned to Contractor.

B. Submit the following to Owner; if submittals under this Section are furnished to Engineer, Engineer will forward all submittals under this Section to Owner without review.

1. Procedures: Site-specific confined space entry plan, submitted upon request of Owner.

2. Permits and Reports: For each time personnel enter a confined space, copies of completed permits required for confined space entry, and completed confined space data sheets, submitted upon request of Owner.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

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SECTION 01 40 00
QUALITY CONTROL AND TESTING SERVICES

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. This specification addresses requirements for testing services specifically required to be provided by the Contractor.

B. Contractor shall employ and pay for independent testing firm(s) to perform specified services covered by this specification along with all other materials testing described in the specifications. Entity selected shall be subject to approval by City.

1.02 STANDARDS

A. ASTM E329: Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection

1.03 QUALIFICATIONS OF MATERIALS TESTING FIRM

A. The testing firm retained by the Contractor shall be qualified in accordance with the criteria in ASTM E329.

1.04 QUALIFICATIONS OF WATER QUALITY TESTING LABORATORY

A. For projects that require water quality testing, comply with the requirements herein.

B. Certification and Accreditation:

1. The laboratory must be certified by the Florida Department of Health's Environmental Laboratory Certification Program.

2. The laboratory shall hold accreditation from the National Environmental Laboratory Accreditation Program (NELAP).

C. Technical Expertise:

1. The laboratory must employ qualified personnel with expertise in chemical and biological testing methods.

2. The laboratory staff must include certified analysts with experience in drinking water quality testing.

D. Compliance with Standards:

1. The laboratory must use analytical methods approved by the Florida Department of Environmental Protection (FDEP) for drinking water compliance monitoring

2. All testing procedures must comply with the standards set forth by the Safe Drinking Water Act.

E. Reporting Forms: Results shall be reported using applicable FDEP forms.

1.05 ADMINISTRATIVE REQUIREMENTS

A. Contractor's Responsibilities:

1. Provide to laboratory representative samples of materials to be tested, in required quantities.

2. Provide labor and facilities:

a. To provide access to the Work to be tested, and where required, to Suppliers' operations.

b. To obtain and handle samples at the Site.

c. To facilitate inspections and tests.

d. For testing entity's exclusive use for storage and curing of test samples.

e. Forms for preparing concrete test beams and cylinders.

3. Notify testing entity and Engineer sufficiently in advance of operations to allow for assignment of personnel and scheduling of tests.

4. Arrange with testing entity and pay for additional services, sampling, and testing required for Contractor's convenience.

5. Provide to testing entity the preliminary design mix proposed for concrete, and other material mixes that require testing by the testing laboratory.

B. Testing Entity's Responsibilities:

1. Cooperate with Contractor and Engineer and provide qualified personnel promptly when notified.

2. Perform specified inspections, sampling, and testing of materials and methods of construction; comply with applicable standards; ascertain compliance with requirements of the Contract Documents.

3. Promptly notify Engineer and Contractor of irregularities or deficiencies in the Work observed during performance of services.

4. Submit specified quantity of report copies of inspections and tests to Contractor and Engineer.

5. Perform additional tests and services as required to ensure compliance with the Contract Documents.

C. Report Requirements:

1. Electronic Submittal of testing reports.

2. Include the following information:

a. Date issued.

b. Project title, number, and name of the Site.

c. Testing laboratory name and address.

d. Name and signature of inspector or person obtaining samples.

e. Date of inspection or sampling.

f. Record of temperature and weather.

g. Date of test.

h. Identification of material or product tested and associated Specification Section.

i. Location in the Project.

j. Type of inspection or test.

k. Results of tests and observations regarding compliance with the Contract Documents.

1.06 SUBMITTALS

A. Submit test reports where required by the Contract Documents in accordance with the Section titled “Submittal Procedures”.

1.07 TESTING SERVICES FURNISHED BY CITY

A. None.

1.08 TESTING SERVICES FURNISHED BY CONTRACTOR

A. Laboratory testing and checking and all certifications required by the Specifications, including the cost of transporting all samples and test specimens, shall be provided by the Contractor unless otherwise indicated in the Specifications.

B. The Contractor shall retain the services of an independent, certified testing laboratory to perform all testing required by the Contract Documents and by permitting agencies. The Contractor shall submit the name of the testing laboratory and evidence of all appropriate certifications for approval by the Engineer and the City.

C. In the case of a conflict between this Specification Section and the Contractor's Quality Management Plan, the more stringent requirement between the two documents shall govern.

D. Procedure

1. The Contractor shall plan and conduct his operations to permit taking of field samples and test specimens, as required, and to allow adequate time for laboratory tests.

2. The collection, field preparation and storage of field samples and test specimens shall be performed by the Contractor as required by the Specifications and as directed by the City.

E. Supplementary and Other Testing: Nothing shall restrict the Contractor from conducting tests it may require. Should the Contractor at any time request the City to consider such test results, the test reports shall be certified by an independent testing laboratory acceptable to the City. Testing of this nature shall be conducted at no additional cost to the City.

1.09 OBSERVATION AT PLACE OF MANUFACTURE

A. Unless otherwise specified, all products, materials, and equipment shall be subject to observation by the Engineer at the place of manufacture.

B. The presence of the Engineer at the place of manufacture however, shall not relieve the Contractor of the responsibility for furnishing products, materials, and equipment which comply with all requirements of the Contract Documents. Compliance is a duty of the Contractor, and said duty shall not be avoided by any act or omission on the part of the Engineer.

1.10 SAMPLING AND TESTING

A. Unless otherwise specified, all sampling and testing shall be in accordance with the methods prescribed in the current standards of the ASTM, as applicable to the class and nature of the article or materials considered; however, the City reserves the right to use

any generally-accepted system of sampling and testing which, in the opinion of the Engineer, will ensure the City that the quality of the work is in full accord with the Contract Documents.

B. Any waiver by the City of any specific testing or other quality assurance measures, whether or not such waiver is accompanied by a guarantee of substantial performance as a relief from the specified testing or other quality assurance requirements as originally specified, and whether or not such guarantee is accompanied by a performance bond to assure execution of any necessary corrective or remedial Work, shall not be construed as a waiver of any requirements of the Contract Documents.

C. Notwithstanding the existence of such waiver, the Engineer reserves the right to make independent investigations and tests and failure of any portion of the Work to meet any of the requirements of the Contract Documents, shall be reasonable cause for the Engineer to require the removal or correction and reconstruction of any such Work in accordance with the General Conditions.

D. Materials to be tested include, but are not necessarily limited to the following:

1. Cement,

2. Concrete aggregate,

3. Concrete,

4. Bituminous paving materials,

5. Structural and reinforcing steel,

6. Waterproofing,

7. Select backfill, subgrade, base material, crushed stone or gravel and sand,

8. Water during pipeline disinfection and bacteriological testing

1.11 SITE INVESTIGATION AND CONTROL

A. The Contractor shall verify all dimensions in the field and shall check field conditions continuously during construction. The Contractor shall be solely responsible for any inaccuracies built into the Work due to its failure to comply with this requirement.

B. The Contractor shall inspect related and appurtenant Work and shall report in writing to the Engineer any conditions which will prevent proper completion of the Work. Failure to report any such conditions shall constitute acceptance of all site conditions, and any required removal, repair, or replacement caused by unsuitable conditions shall be performed by the Contractor within the scope of the Project.

1.12 OBSERVATION AND TESTING

A. The work or actions of the testing laboratory shall in no way relieve the Contractor of its obligations under the Contract. The laboratory testing work will include such observations and testing required by the Contract Documents, existing laws, codes, ordinances, etc. The testing laboratory will have no authority to change the requirements of the Contract Documents, nor perform, accept or approve any of the Contractor's Work.

B. The Contractor shall allow the Engineer ample time and opportunity for field observation and testing materials and equipment to be used in the Work. The Contractor shall advise the Engineer promptly upon placing orders for materials and equipment so that arrangements may be made, if desired, for observation before shipment from the place of manufacture. The Contractor shall at all times furnish the Engineer and its representatives, facilities including labor, and allow proper time for inspecting and testing materials, equipment, and installation. The Contractor must anticipate that possible delays may occur in the execution of its work due to the necessity of materials and equipment being inspected and accepted for use. The Contractor shall furnish, at its own expense, all samples of materials required by the Engineer for testing, and shall make its own arrangements for providing water, electric power, or fuel for the various observations and tests of structures and equipment.

C. The Contractor shall furnish the services of representatives of the manufacturers of certain equipment, as prescribed in other Sections of the Specifications. The Contractor shall also place its orders for such equipment on the basis that, after the equipment has been tested prior to final acceptance of the work, the manufacturer will furnish the City with certified statements that the equipment has been installed properly and is ready to be placed in functional operation. Tests and analyses required of equipment shall be paid for by the Contractor, unless specified otherwise in the Section which covers a particular piece of equipment.

D. Where other tests or analyses are specifically required in other Sections of these Specifications, the cost thereof shall be borne by the party (City or Contractor) so designated in such Sections. The City will bear the cost of all tests, observations, or investigations undertaken by the order of the Engineer for the purpose of determining conformance with the Contract Documents if such tests, observations, or investigations are not specifically required by the Contract Documents, and if conformance is ascertained thereby. Whenever nonconformance is determined by the Engineer as a result of such tests, observations, or investigations, the Contractor shall bear the full cost thereof or shall reimburse the City for said cost. In this connection, the cost of any additional tests and investigations, which are ordered by the Engineer to ascertain subsequent conformance with the Contract Documents, shall be borne by the Contractor.

E. Significance of Tests: Test results shall be binding on both the Contractor and the City, and shall be considered irrefutable evidence of compliance or noncompliance with the Specification requirements, unless supplementary testing shall prove, to the satisfaction of the City, that the initial samples were not representative of actual conditions.

F. Supplementary and Other Testing: Nothing shall restrict the Contractor from conducting tests he may require. Should the Contractor at any time request the City to consider such test results, the test reports shall be certified by an independent testing laboratory acceptable to the City. Testing of this nature shall be conducted at the Contractor's expense.

1.13 RIGHT OF REJECTION, IMPERFECT WORK, EQUIPMENT, OR MATERIALS

A. The Engineer, acting for the City, shall have the right, at all times and places, to reject any articles or materials to be furnished hereunder which, in any respect, fail to meet the requirements of the Contract Documents, regardless of whether the defects in such articles or materials are detected at the point of manufacture or after completion of the Work at the site, or during the subsequent guarantee period. If the Engineer or its representative, through an oversight or otherwise, has accepted materials or Work which is defective, or which is contrary to the Contract Documents, such materials, no matter in what stage or condition of manufacture, delivery, or erection, may be subsequently rejected by the Engineer for the City. Any defective or imperfect work, equipment, or materials furnished by the Contractor which is discovered shall be removed immediately even though it may have been overlooked by the Engineer and estimated for payment. Satisfactory work or materials shall be substituted for that rejected.

B. The Contractor shall promptly remove rejected articles or materials from the site of the Work after notification of rejection. All costs of removal and replacement of rejected articles or materials as specified herein shall be borne by the Contractor.

C. The Engineer may order tests of imperfect or damaged work, equipment, or materials to determine the required functional capability for possible acceptance, if there is no other reason for rejection. The cost of such tests shall be borne by the Contractor; and the nature, tester, extent and supervision of the tests will be as determined by the Engineer. If the results of the tests indicate that the required functional capability of the work, equipment, or material was not impaired, consistent with the final general appearance of same, the work, equipment, or materials may be deemed acceptable. If the results of such tests reveal that the required functional capability of the questionable work, equipment, or materials has been impaired, then such work, equipment, or materials shall be deemed imperfect and shall be replaced. The Contractor may elect to replace the imperfect work, equipment, or material in lieu of performing the tests.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.01 BUOYANCY

A. The Contractor shall be completely responsible for any tanks, pipelines, utility access, foundations or similar improvements that may become buoyant during the construction

operations due to groundwater levels. Should there be any possibility of buoyancy, the Contractor shall take the necessary steps to prevent damage due to floating or flooding and shall repair or replace said improvements at no additional cost to the City.

END OF SECTION

SECTION 01 42 00

REFERENCES

PART 1 – GENERAL

1.01 SUMMARY

A. Definitions and terminology applicable to all the Contract Documents are included in the General Conditions and Supplementary Conditions.

1.02 REFERENCES

A. Abbreviations and Acronyms: Common abbreviations that may be found in the Contract Documents are listed below:

alternating current	AC
ampere	A
Architectural Barriers Act	ABA
Americans with Disabilities Act	ADA
Americans with Disabilities Act Accessibility Guidelines	ADAAG
ante meridian	a.m.
average	avg
biochemical oxygen demand	BOD
brake horsepower	bhp
Broward County Resilient Environment Department	BCRED
British thermal unit	Btu
Centigrade (or Celsius)	C
chlorinated polyvinyl chloride	CPVC
Code of Federal Regulations	CFR
cubic inch	cu in
cubic foot	cu ft
cubic yard	cub yd, or CY
cubic feet per minute	cfm

cubic feet per second	cfs
degree Centigrade (or Celsius)	degrees C or ºC
degrees Fahrenheit	degrees F or ºF
diameter	dia
direct current	DC
dollars	$
each	ea
efficiency	eff
Fahrenheit	F
feet	ft
feet per hour	fph
feet per minute	fpm
feet per second	fps
figure	Fig
flange	flg
Florida Building Code	FBC
Florida Department of Environmental Protection	FDEP
Florida Department of Transportation	FDOT
foot-pound	ft-lb
gallon	gal
gallons per hour	gph
gallons per minute	gpm
gallons per second	gps
gram	g
grams per liter	g/L
Hertz	Hz
horsepower	hp or HP
hour	hr

human-machine interface	HMI
inch	in.
inches water gage	in. w.g.
inch-pound	in.-lb
inside diameter	ID
iron pipe size	IPS
thousand pounds	kips
thousand pounds per square inch	ksi
kilovolt-ampere	kva
kilowatt	kW
linear foot	lin ft or LF
liter	L
maximum	max
mercury	Hg
milligram	mg
milligrams per liter	mg/l or mg/L
milliliter	ml
millimeter	mm
million gallons per day	mgd or MGD
million gallons	MG
minimum	min
national pipe threads	NPT
net positive suction head	NPSH
net positive suction head available	NPSHA
net positive suction head required	NPSHR
nominal pipe size	NPS
number	no.
operator interface terminal	OIT

ounce	oz
ounce-force	ozf
outside diameter	OD
parts per hundred	pph
parts per million	ppm
parts per billion	ppb
polyvinyl chloride	PVC
post meridian	p.m.
pound	lb
pounds per square inch	psi
pounds per square inch absolute	psia
pounds per square inch gauge	psig
pounds per square foot	psf
process control system	PCS
programmable logic controller	PLC
revolutions per minute	rpm
second	sec
specific gravity	sp gr or SG
square	sq
square foot	sq ft or sf or SF
square inch	sq in.
square yard	sq yd or SY
standard	std
standard cubic feet per minute	scfm
total dynamic head	TDH

B. Definitions: Terminology used in the Specifications includes:

1. “Indicated” refers to graphic representations, notes, or schedules on the Drawings, or to other paragraphs or schedules in the Specifications and similar locations in the Contract Documents.

2. “Shown”, “noted”, “scheduled”, and “specified” are used to help the user locate the reference without limitation on the location.

3. “Installer”, “applicator”, or “erector” is Contractor or another entity engaged by Contractor, either as an employee or subcontractor, to perform a particular construction activity, including installation, erection, application or similar Work. Installers shall be experienced in the Work that installer is engaged to perform.

4. “Experienced”, when used with the term “installer” means having successfully completed a minimum of five previous projects similar in size and scope to this Project; being familiar with the special requirements indicated; being familiar with Laws and Regulations; and having complied with requirements of authorities having jurisdiction, and complying with requirements of the Supplier of the material or equipment being installed.

5. Trades: Use of a term such as “carpentry” does not imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as “carpenter”, unless otherwise indicated in the Contract Documents or required by Laws or Regulations. Such terminology also does not imply that specified requirements apply exclusively to trade personnel of the corresponding generic name.

6. “Assigned specialists” and similar terms: Certain Sections of the Specifications require that specific construction activities be performed by specialists recognized as experts in those operations. Engage said specialists for those activities, and their engagement is a requirement over which Contractor has no option. These requirements do not conflict with enforcement of building codes and other Laws and Regulations. Also, such requirements are not intended to interfere with local trade union jurisdictional settlements and similar conventions. Such assignments shall not relieve Contractor of responsibility for complying with the requirements of the Contract Documents.

C. Reference Standards:

1. Refer to General Conditions, as may be modified by the Supplementary Conditions, relative to reference standards and resolving discrepancies between reference standards and the Contract Documents. Provisions of reference standards are in effect in accordance with the Specifications.

2. Copies of Standards: Each entity engaged in the Work shall be familiar with reference standards applicable to its construction activity. Copies of applicable reference standards are not bound with the Contract Documents. Where reference

standards are needed for a construction activity, obtain copies of standards from the publication source.

3. Abbreviations and Names: Where reference standards, specifications, codes, manuals, Laws or Regulations, or other published data of international, national, regional or local organizations are referred to in the Contract Documents, the organization issuing the standard may be referred to by their acronym or abbreviation only.

4. Following acronyms or abbreviations that may appear in the Contract Documents shall have the meanings indicated below. Listing is alphabetical by acronym.

AA	Aluminum Association
AABC	Associated Air Balance Council
AAMA	American Architectural Manufacturers Association
AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
ACIFS	American Cast Iron Flange Standards
ACS	American Chemical Society
ADC	Air Diffusion Council
ADSC	International Association of Foundation Drilling.
AEIC	Association of Edison Illuminating Companies
AF&PA	American Forest and Paper Association
ABMA	American Bearing Manufacturers Association (formerly Anti- Friction Bearing Manufacturers Association (ABMA))
AGA	American Gas Association
AGMA	American Gear Manufacturers Association
AHDGA	American Hot Dip Galvanizers Association
AI	Asphalt Institute
AIA	American Institute of Architects
AIChE	American Institute of Chemical Engineers
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AITC	American Institute of Timber Construction

ALSC	American Lumber Standards Committee
AMA	Acoustical Materials Association
AMCA	Air Movement and Control Association
AMP	National Association of Architectural Metal Manufacturers, Architectural Metal Products Division
ANSI	American National Standards Institute
APA	The Engineered Wood Association
API	American Petroleum Institute
APHA	American Public Health Association
AREA	American Railway Engineering Association
ARI	Air Conditioning and Refrigeration Institute
ASA	American Standards Association
ASAE	American Society of Agricultural Engineers
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASNT	American Society for Non-Destructive Testing
ASQ	American Society for Quality
ASSE	American Society of Safety Engineers
ASTM	American Society for Testing and Materials
AWCI	Association of the Wall and Ceiling Industry
AWI	Architectural Woodwork Institute
AWPA	American Wood Protection Association
AWPI	American Wood Preservers Institute
AWS	American Welding Society
AWWA	American Water Works Association
BAAQMD	Bay Area Air Quality Management District
BHMA	Builders Hardware Manufacturers Association
BIA	Brick Industry Association

BOCA	Building Officials and Code Administrators
CBMA	Certified Ballast Manufacturers Association
CDA	Copper Development Association
CEMA	Conveyor Equipment Manufacturers Association
CGA	Compressed Gas Association
CISCA	Ceilings and Interior Systems Construction Association
CISPI	Cast Iron Soil Pipe Institute
CLFMI	Chain Link Fence Manufacturers Institute
CMAA	Crane Manufacturers Association of America
CPSC	Consumer Product Safety Commission
CRSI	Concrete Reinforcing Steel Institute
CSI	Construction Specifications Institute
DIN	Deutsches Institut fur Normung eV (German Institute for Standardization)
DIPRA	Ductile Iron Pipe Research Association
EJCDC	Engineers Joint Contract Documents Committee
EJMA	Expansion Joint Manufacturers Association, Inc.
ETL	Intertek Testing Services, Inc. (formerly ETL Testing Laboratories, Inc.)
FCC	Federal Communications Commission
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
FM	Factory Mutual (FM Global)
FRPI	Fiberglass Reinforced Plastics Institute
FS	Federal Specification
GA	Gypsum Association
GANA	Glass Association of North America
HEW	United States Department of Health, Education and Welfare
HI	Hydraulic Institute
HMI	Hoist Manufacturers Institute

HUD	United States Department of Housing and Urban Development
IBC	International Building Code
ICC	International Code Council
ICEA	Insulated Cable Engineers Association
IEEE	Institute of Electrical and Electronics Engineers
IESNA	Illuminating Engineering Society of North America
IFI	Industrial Fasteners Institute
IFCEA	Insulated Power Cable Engineers Association
IRI	Industrial Risk Insurers
ISA	Instrumentation, Systems, and Automation Society (formerly Instrument Society of America)
ISO	Insurance Services Office
IOS	International Organization for Standardization
LPI	Lightning Protection Institute
MIA	Marble Institute of America
ML/SFA	Metal Lath/Steel Framing Association
MS	Military Specifications
MSS	Manufacturers' Standardization Society
MMA	Monorail Manufacturers Association
NAAMM	National Association of Architectural Metal Manufacturers
NACE	National Association of Corrosion Engineers
NAPF	National Association of Pipe Fabricators, Inc.
NARUC	National Association of Regulatory Utilities Commissioners
NBHA	National Builders Hardware Association
NBS	United States Department of Commerce, National Bureau of Standards
NCMA	National Concrete Masonry Association
NEC	National Electric Code
NELMA	Northeastern Lumber Manufacturers' Association
NEMA	National Electrical Manufacturers Association

NESC	National Electrical Safety Code
NETA	International Electrical Testing Association
NFPA	National Fire Protection Association
NFRC	National Fenestration Rating Council
NGA	National Glass Association
NHLA	National Hardwood Lumber Association
NHPMA	Northern Hardwood and Pine Manufacturers Association
NIST	United States Department of Commerce, National Institute of Standards and Technology
NLGA	National Lumber Grades Authority
NRCA	National Roofing Contractors Association
NRMCA	National Ready Mixed Concrete Association
NSF	National Sanitation Foundation
NSSGA	National Stone, Sand, and Gravel Association
NTMA	National Terrazzo and Mosaic Association
OSHA	Occupational Safety and Health Administration
PCA	Portland Cement Association
PCI	Precast/Prestressed Concrete Institute
PEI	Porcelain Enamel Institute
PFI	Pipe Fabrication Institute
PPI	Plastics Pipe Institute
PGMC	Primary Glass Manufacturers Council
PS	Product Standards Section, United States Department of Commerce
RCSC	Research Council on Structural Connections (part of AISC)
RMA	Rubber Manufacturers Association
SAE	Society of Automotive Engineers
SBCCI	Southern Building Code Congress International, Inc.
SCAQMD	Southern California Air Quality Management District
SCPRF	Structural Clay Products Research Foundation

SCTE	Society of Cable Telecommunications Engineers
SDI	Steel Deck Institute
SDI	Steel Door Institute
SIGMA	Sealed Insulating Glass Manufacturing Association
SJI	Steel Joist Institute
SMACNA	Sheet Metal and Air Conditioning Contractor's National Association
SPI	Society of the Plastics Industry
SPIB	Southern Pine Inspection Bureau
SSPC	Society for Protective Coatings
SWI	Steel Window Institute
TCNA	Tile Council of North America
TEMA	Tubular Exchanger Manufacturers Association
TIA/EIA	Telecommunications Industry Association/Electronic Industries Alliance
UBC	Uniform Building Code
UL	Underwriters Laboratories, Inc.
USAB	United States Access Board
USDOE	United States Department of Energy
USEPA	United States Environmental Protection Agency
USGBC	United States Green Building Council
USGS	United States Geological Survey
USPHS	United States Public Health Service
WCLIB	West Coast Lumber Inspection Bureau
WCMA	Window Covering Manufacturers Association
WCMA	Wood Component Manufacturers Association
MDMA	Window and Door Manufacturers Association
WWEMA	Water and Wastewater Equipment Manufacturers Association
WWPA	Western Wood Products Association

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01 45 33

SPECIAL INSPECTIONS

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The CONTRACTOR, in accordance with Section 110.10 of the Broward County Amendments to the Florida Building Code, shall retain a Special Inspector to perform the applicable inspections outlined in Sections 110.10 of the Broward County Amendments to the Florida Building Code.

B. The Special Inspector shall be a Professional Engineer licensed in the State of Florida.

C. At a minimum, the following inspections shall be provided:

1. Precast concrete units – Sections 1927.12.1, 1927.12.2 and 109.11.2.1

2. Reinforced unit masonry – Section 2122.4 and 109.11.2.2

3. Connections – Sections 109 11 2 3, 110.10.2.3 and 2218.2

D. Additional inspections may be required at the discretion of the Building Official per Section 110.10.1 of the Broward County Amendments to the Florida Building Code.

E. It is recognized that the scope of services associated with providing the special inspector services cannot be quantified until the Contractor applies for a Building Permit with the City of Hollywood Building Department and the Building Department defines the scope of special inspections. For the purposes of establishing a scope for the inspections, the Contractor shall assume an allowance amount as indicated on the Bid Form to pay for professional engineering services.

F. The allowance amount is an estimate and is a cost pass through item and no mark-ups will be added to this item. The Contractor shall produce documentation upon request verifying actual cost. Any portion of the allowance that remains after all authorized payments have been made will be withheld from contract payments and will remain with the OWNER.

1.02 SPECIAL BUILDING INSPECTOR FORM

A. Contractor shall prepare and submit the Form for “Special Building Inspection” as required by the Building Department with jurisdiction. The form shall be executed by the Professional Engineer licensed in the state of Florida.

B. Provide a copy of the form that is submitted to the Building Department to the Engineer and the City for informational purposes.

1.03 INSPECTION REPORTS

A. Prepare a log of all progress reports and inspections related to the Special Inspections required by the Building Official. The log shall be maintained at the job site.

B. On a weekly basis submit signed and sealed progress reports and inspection reports to the Building Official as per Section 110.10.6.2 of the Broward County Amendments to the Florida Building Code.

C. Provide copies of the reports that are submitted to the Building Department to the Engineer and the City for informational purposes.

1.04 CERTIFICATION

A. The Special Inspector shall submit a signed and sealed Certificate of Compliance at the completion of the work in accordance with Section 110.10.7 of the Broward County Amendments to the Florida Building Code.

B. The Certificate of Compliance shall state that the work performed by the Contractor was done, substantially in accordance with the applicable portion of the permitted construction documents as delineated in the special building inspection plan.

C. Furnish a copy of the Certificate of Compliance to the City and the Engineer.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01 51 00

TEMPORARY UTILITIES

PART 1 – GENERAL

1.01 SUMMARY

A. Contractor shall provide temporary utilities required for the Project and to complete the Work.

1. Make arrangements with utility service companies for temporary services and obtain required permits and approvals for temporary utilities.

2. Pay utility service costs, including connection fees, required for the Work as needed.

3. Continuously maintain adequate utilities for all purposes during the Project, until removal of temporary utilities and temporary facilities. At minimum, provide and maintain temporary utilities through Substantial Completion and removal of temporary field offices and sheds.

4. Should Owner occupy part of the Project prior to Substantial Completion of the entire Work, cost of utilities consumed via temporary utilities serving the portion occupied by Owner will be shared proportionately between Owner and Contractor as mutually agreed to by the parties.

5. Maintain, including cleaning, temporary utilities and continuously provide consumables as required.

6. Temporary utilities and temporary facilities shall be adequate for personnel using the Site and requirements of Project.

7. Provide temporary utilities and temporary facilities in compliance with Laws and Regulations and, when applicable, requirements of utility owners.

B. Provide the following temporary utilities:

1. Electricity and lighting.

2. Sanitary facilities.

3. Water service.

4. First-aid facilities.

5. Fire protection.

1.02 ADMINSTRATIVE REQUIREMENTS

A. Use of Owner's System:

1. Existing Utility Systems: Do not use systems in existing buildings or structures for temporary utilities without Owner's written permission and mutually acceptable basis agreed upon by the parties for proportionate sharing of costs between Owner and Contractor.

2. Use of Permanent Utility Systems Provided Under the Project:

a. Permanent lighting, water, heating, ventilating, and fire protection systems and first-aid facilities may be used to provide temporary utilities and temporary facilities if the following are met:

1) Obtain Owner's written permission to use permanent systems.

2) Permanent systems to be used for temporary utilities or temporary facilities shall have achieved Substantial Completion, including complete functionality of all controls.

3) Contractor shall pay all costs while using permanent system, including operation, maintenance, replacement of consumables, and provide replacement parts.

b. Do not use the following permanent facilities:

1) Telephone and communication facilities.

2) Sanitary facilities.

1.03 SYSTEM DESCRIPTION

A. Electricity and lighting:

1. Contractor shall provide electrical and lighting service for construction field offices, sheds, storage containers, etc. and as required for the Work.

2. General 120/240 V service requirements:

a. Contractor shall provide 120/240 V, single phase, 3-wire temporary system for small power requirements and general lighting.

b. Contractor shall provide main disconnect, overcurrent protection, meter outlet, branch circuit breakers, and wiring for temporary service to the Contractor's field office service connections. Contractor shall provide

equipment and appurtenances in accordance with electricity service provider and applicable standards and codes

c. Contractor shall register the 120/240 V electrical service meter in the Contractor's name and shall be responsible for electrical charges at no additional cost to the Owner.

d. Contractor shall provide electrical service other than 120/240 V, single phase, 3-wire service as required for the Work at the Contractor's own expense.

3. General lighting requirements:

a. Contractor shall provide a minimum of 10 foot candles for enclosed and partially enclosed structures for performing the Work.

b. Contractor shall provide a night lighting circuit for security. Light intensity shall be a minimum of 2 foot candles.

4. Contractor shall energize the electrical system 15-minutes prior to and following regular work day hours at the Site. Required from Monday through Friday, all inclusive.

5. Contractor shall energize the night lighting system at end of typical working day and de-energize at start of typical working day. System shall be continuously energized on Saturdays, Sundays, and holidays.

6. Contractor shall provide an independent grounding cable connected directly to the structure, building, and equipment for erection and fabrication by electrical welders. Grounding by adjacent conduit, piping, etc. shall be prohibited at the Site.

7. Contractor shall coordinate usage of temporary electrical system with Subcontractors, Suppliers, and Owner including the following:

a. Usage is suitable for 120V, single phase, 60 Hz operation with a maximum operating input of 1,500 volt-amperes.

b. One unit connected to a single outlet.

c. Restrict usage in case of overloading circuits to correct loading.

B. Telephone and communications: Contractor shall provide temporary telephone and communications required for its operations at the Site and for summoning emergency medical assistance.

C. Heating/Ventilation/Air Conditioning:

1. Contractor shall provide temporary heating, ventilation and air conditioning coverings and enclosures necessary to protect the Work and materials against wetness and temperature damage, to dry out the Work, and to facilitate the Work in structures.

2. Equipment, fuel, materials, personnel and methods used shall be adequate to maintain critical installation temperatures and ventilation of Work at all times in areas where necessary to perform the Work.

3. Enclosed structures shall have a minimum temperature of 50°F, unless otherwise specified, where Work is performed.

4. Contractor shall provide sufficient heat to maintain a minimum temperature of 65°F before and during application of interior finishing, painting, coating, etc.

5. Contractor shall replace any Work damaged by dampness or insufficient/abnormal heating at no cost to the Owner.

D. Sanitary facilities:

1. Contractor shall provide suitably-enclosed chemical or self-contained toilets for Contractor's employees and visitors to the Site. Location of temporary toilets shall be acceptable to Owner and screened from public observation.

2. Facilities shall be maintained and provided in accordance with State or Commonwealth Labor Regulations and local ordinances. Contents shall be removed and disposed in accordance with local and state or commonwealth regulations as required.

3. Contractor shall be prohibited from committing nuisances within, on, or in the vicinity of the Site.

E. Water service:

1. Contractor shall provide temporary water service for the Work including for construction purposes, sanitary facilities, fire protection, field office, and cleaning purposes.

2. Contractor shall provide potable water for Contractor's personnel either by portable containers or drinking fountains.

3. Contractor shall provide temporary hose bibs, hoses, and watertight barrels for the distribution of water.

4. Contractor shall provide freeze protection for water service.

F. First-aid facilities:

1. Contractor shall provide temporary first-aid stations at or immediately adjacent to the Site's major work areas. Contractor shall provide temporary first-aid stations inside its temporary field office. Locations of first-aid stations shall be determined by Contractor's safety representative.

2. Contractor shall provide list of emergency telephone numbers at each hardwired telephone at the Site. List shall be in accordance with the list of emergency contact information required in Section 01 31 19 – Project Meetings.

G. Fire protection:

1. Contractor shall comply with NFPA 241, Safeguarding Building Construction, Alteration, and Demolition Operations, and requirements of fire marshals and authorities having jurisdiction at the Site.

2. Contractor shall provide temporary fire exits, fire extinguishers, hoses and safety devices as required by authorities having jurisdiction.

3. Contractor shall notify Engineer, Owner, and fire marshals in the event of fire at the Site including, but not limited to, fuel tanks and similar hazardous utilities and devices. Contractor shall cooperate with Owner of fuel tank and utilities to prevent occurrence of fire or explosion.

4. Contractor shall perform safety precautions and comply with fire marshal's instructions in the event of fire.

PART 2 – PRODUCTS

2.01 EQUIPMENT

A. Materials and equipment for temporary systems may be new or used but shall be adequate for purposes intended and shall not create unsafe conditions and shall comply with Laws and Regulations.

B. Provide required materials, equipment, and facilities, including piping, wiring, and controls.

C. Electrical system requirements: System shall consist of wiring, switches, insulated supports, poles, fixtures, sockets, receptacles, lamps, guards, cutouts and fuses as required for completion of the Work.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install temporary facilities in neat, orderly, manner, and make structurally, mechanically, and electrically sound throughout.

B. Location of Temporary Utilities and Temporary Facilities:

1. Locate temporary systems for proper function and service.

2. Temporary systems shall not interfere with or provide hazards or nuisances to: the Work under this and other contracts, movement of personnel, traffic areas, materials handling, hoisting systems, storage areas, finishes, and work of utility companies.

3. Do not install temporary utilities on the ground, with the exception of temporary extension cords, hoses, and similar systems in place for short durations.

C. Modify and extend temporary systems as required by progress of the Work.

3.02 MAINTENANCE

A. Maintain temporary systems to provide safe, continuous service as required.

B. Properly supervise operation of temporary systems:

1. Enforce compliance with Laws and Regulations.

2. Enforce safe practices.

3. Prevent abuse of services.

4. Prevent nuisances and hazards caused by temporary systems and their use.

5. Prevent damage to finishes.

6. Ensure that temporary systems and equipment do not interrupt continuous progress of construction.

C. At end of each work day, check temporary systems and verify that sufficient consumables are available to maintain operation until work is resumed at the Site. Provide additional consumables if the supply on hand is insufficient.

D. Contractor shall replace broken and burned out lamps, blown fuses, and damaged wiring and appurtenances as required to maintain adequate and safe operating conditions.

E. Contractor shall permit subcontractors and others at a mutually agreed arrangement to use temporary electrical system that meet the following requirements:

1. Equipment are suitable for 120 V, single phase, 60 Hz operation.

2. Operating input does not exceed 1,500 volt-amperes.

3. Single piece of equipment connected to one outlet.

4. Contractor shall restrict use of equipment as required to prevent overloading circuits.

3.03 CLOSEOUT ACTIVITES

A. Completely remove temporary utilities, facilities, equipment, and materials when no longer required. Repair damage caused by temporary systems and their removal and restore the Site to condition required by the Contract Documents; if restoration of damaged areas is not specified, restore to preconstruction condition.

B. Contractor is responsible for and shall return to original condition those portions of permanent electric system used in completing the Work.

C. Where temporary utilities are disconnected from existing utility, provide suitable, watertight or gastight (as applicable) cap or blind flange, as applicable, on service line, in accordance with requirements of utility owner.

D. When permanent utilities and systems that were used for temporary utilities, upon Substantial Completion replace all consumables such as filters and light bulbs and parts used during the Work.

END OF SECTION

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SECTION 01 52 00

CONSTRUCTION FACILITIES

PART 1 – GENERAL

1.01 SUMMARY

A. Contractor shall provide construction facilities as needed for performance of the Work, including the following:

1. Contractor's field office, sheds, and storage containers that shall be erected within 30 days of Notice to Proceed on the Project.

2. Project sign and panel that shall be erected within 21 days of Notice to Proceed on the Project.

1.02 FACILITY DESCRIPTION

A. Contractor's Field Office, Sheds, and Storage:

1. Contractor shall provide and maintain a field office at the Site, including temporary utility services specified.

2. Size and Furnishings: As required by Contractor

3. Features: Exterior Contractor identification sign, night lighting for security, and temporary utilities specified in Section 01 51 00 – Temporary Utilities.

4. Location: To be approved by the Owner .

5. Contractor shall provide and maintain one set of Contract Documents, latest approved Shop Drawings, Field Orders, request for interpretations, clarification notices, Work Change Directives, proposal requests, Change Proposals, Change Orders, and other pertinent Project related correspondence.

6. Hurricane/permit

B. Project Identification Sign:

1. Contractor shall provide in accordance to this Section.

2. Contractor shall maintain project identification sign for the duration of the Contract.

3. Contractor shall remove and dispose of project identification sign at the completion of the Project when notified by the Engineer.

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4. Contractor shall not receive additional payment for deterioration or replacement of names and other pertinent sign information throughout the duration of the Project.

1.03 GENERAL FIELD OFFICE REQUIREMENTS

A. The Contractor shall provide steps and platforms with handrails to permit entry to the offices. This work shall conform to the Florida Building Code and OSHA requirements.

B. The trailers shall be blocked up and hurricane straps installed conforming to the applicable building codes.

C. The Contractor is responsible for procuring all necessary permits for the installation of the field offices at the location noted on the Drawings.

1.04 SUBMITTALS

A. Action/Informational Submittals: Project identification sign layout, details, and materials of construction.

B. Prior to installation of the field trailer, Contractor shall submit a certification from the supplier indicating that trailer walls, floor, and ceiling are free from mold.

1.05 UTILITIES FOR FIELD OFFICES

A. The Contractor shall arrange with Florida Power and Light (FPL) for construction power service and pay all costs for the Work and power necessary for the field offices. The Contractor shall be responsible for all connections and wiring to and from the point of service. In addition, the Contractor shall coordinate with the local utility to arrange startup and invoicing for service.

B. Telephone service connections shall be obtained from off-site by the CONTRACTOR. The CONTRACTOR shall be responsible for all connections and wiring between the telephone carrier service point and the field office. In addition, the CONTRACTOR shall coordinate with the local phone company to arrange startup and invoicing for service.

C. Water service to the trailer will be furnished by the existing potable water line at the field office area. Water supply shall be in accordance with the Section entitled “Temporary Utilities.” Cleaning, flushing, and related permit requirements for all connections are the Contractor’s responsibility.

D. Sanitary service to the trailers will be furnished by the existing drain system in the field office area. The Contractor shall be responsible for connection and piping requirements between this line and its office trailer to meet all applicable code and regulatory requirements.

E. The Contractor retains responsibility for procuring all necessary permits for the installation of field offices at the locations noted.

F. The Contractor shall familiarize itself with the existing power, telephone, water and sewer connections. All costs associated with “hooking-up” to these existing items shall be included in the Contractor’s base bid.

PART 2 – PRODUCTS

2.01 COMPONENTS

A. Project Identification Sign

1. Sign Panel: 3/4-inch thickness (minimum) marine plywood rabbeted in a 2” x 4” wood frame. Panel shall be fastened to sign supports with six 3/8” dia galvanized bolts, nuts and washers (minimum).

2. Sign Supports: Two, 4” x 4” treated wood posts.

3. Fasteners and Hardware: Galvanized

4. Painting: Supports, trim and back of sign panel shall be painted with two coats (minimum) of same paint for sign face. Paint shall be exterior grade paint, suitable for wood application and in accordance with Section 09 90 00 – Painting.

5. Wording, Colors, and Arrangement: As selected by Owner

6. Contractor shall submit a shop drawing for the Project Sign for approval by Engineer and Owner prior to mobilizing on site.

PART 3 – EXECUTION (NOT USED)

END OF SECTION

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SECTION 01 55 00

CONTRACTOR ACCESS AND PARKING

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Contractor shall provide and maintain temporary laydown and employee parking areas and appurtenances required during the Project for use by Contractor, other contractors employed on the Project, Owner's, and emergency vehicles.

2. Laydown and employee parking areas shall be designed and maintained by Contractor and shall be fully passable to vehicles in all weather conditions.

1.02 ADMINSTRATIVE REQUIREMENTS

A. Access roads:

1. Contractor shall construct and maintain such temporary access roads as required to perform the Work.

2. Contractor shall construct access roads, where possible, in locations over the areas of future road systems.

3. Access roads shall be located within the property lines of the Owner unless the Contractor independently secures easements for use and convenience.

a. Contractor shall submit written documentation to the Engineer for Contractor secured easements across privately held property.

b. Easement agreements shall specify terms and conditions of use and provisions for Site restoration.

c. Written release from property owner certifying that terms of the easement agreement have been complied by the Contractor shall be furnished to the Engineer prior to final payment.

B. Use of existing access roads:

1. Contractor will be allowed to use Owner's existing roads as shown on the Drawings.

2. Prevent interference with traffic on existing roads and parking areas. At all times, keep access roads and entrances serving the Site clear and available to Owner,

Owner's employees, emergency vehicles, and other contractors. Do not use access roads or Site entrances for parking or storage of materials or equipment.

3. Contractor shall indemnify and hold harmless Owner and Engineer from expenses caused by Contractor's operations over existing roads and parking areas.

4. Schedule deliveries to minimize use of driveways and Site entrances.

5. Contractor shall suitably maintain existing access road at Contractor's expense for the duration of the Contract time.

C. State/Commonwealth and local regulations:

1. Contractor shall obtain and pay all cost associated with bonds required by authorized entity (i.e. State or Commonwealth Department of Transportation) for the use of State or Commonwealth maintained roads.

2. Contractors shall obey traffic laws and comply with requirements, rules and regulations of the authorized entity (i.e. State or Commonwealth Department of Transportation), including local authorities having jurisdiction, to maintain warning signs, lights, barriers, etc. for the protection of traffic on public roadways.

D. Site security:

1. Contractor shall safely guard all the Work, the Project, products, equipment, and property from loss, theft, damage, and vandalism until Substantial Completion. Contractor's duty includes safely guarding Owner's property in vicinity of the Work and Project, and other private property in the vicinity of the Project from injury and loss in connection with performance of the Project.

2. Employ watchmen as required to provide required security and prevent unauthorized entry.

3. Costs for security required under this Section shall be paid by Contractor.

4. Make no claim against Owner for damage resulting from trespass.

5. Pay full compensation for, or repair or replace, damage to property of Owner and others arising from failure to furnish adequate security.

6. Provide temporary fencing in accordance with the Contract Documents.

7. Security requirements specified in the Section shall begin as soon as the contractor delivers materials to the Site and/or begins work, and shall continue until the date of Final Completion.

8. Procedures:

a. Contractor shall conform to Owner's security procedures and access restrictions at Site throughout entire Project.

b. Contractor, including Subcontractors and Suppliers, shall comply with the following:

1) Personnel Identification: All Contractor personnel shall wear at all times on-Site a badge bearing Contractor's name, employee's name and, as applicable, employee number.

2) Parking: Do not park outside of designated Contractor parking area, which is shown on the Drawings. Prepare and maintain parking area as required. Personal vehicles are not allowed outside Contractor parking area.

9. Contractor shall provide and maintain temporary security fencing if existing security fencing or barriers are breached or temporarily removed for the Project at no additional cost to the Owner. Temporary security fencing shall be equal to existing, unless otherwise specified, and provided and maintained in a manner satisfactory to Engineer and Owner.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.01 INSTALLATION

A. Contractor shall determine if and where temporary fencing is necessary, unless existing security fencing is damaged, which will be determined by Engineer and Owner.

B. Install temporary fencing used for site security in accordance with the Contract Documents and fence manufacturer's instructions. Provide temporary fencing for site security so that integrity of site security is maintained throughout the Project.

C. Maintain temporary fencing. Repair damage to temporary fencing and replace fencing when required to maintain site security.

D. Remove temporary fencing when permanent site security fencing is in place and fully functional, or when otherwise directed by Owner or Engineer.

END OF SECTION

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SECTION 01 57 00

TEMPORARY CONTROLS

PART 1 – GENERAL

1.01 SUMMARY

A. Contractor shall provide and maintain methods, equipment, and temporary construction as required to control environmental conditions at the Site and adjacent areas.

B. Maintain controls until no longer required.

C. Temporary controls include, but are not limited to, the following:

1. Dust control.

2. Noise controls.

3. Pest and rodent control.

4. Pollution control.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.01 DUST CONTROL

A. Contractor shall take measures to control dust from Contractor's operations and prevent spillage of excavated materials on public roads.

B. Contractor shall remove spillage of excavated materials, debris and dust from public roads by methods approved by Engineer.

C. Contractor shall provide temporary dust-proof partitions where required to protect unaltered portions of existing structures and facilities and as directed by Engineer or Owner. Temporary partitions shall be provided where demolition Work is required, to protect equipment and material, and shall consist of the following:

1. Wood studs with plywood on both sides and extend from floor to ceiling.

2. Closure plate at floor and ceiling.

3. One door (minimum) with hardware.

D. Contractor shall refer to applicable sections of local and state/commonwealth regulations on dust control for additional guidance.

1. Contractor shall apply water at locations, quantities, and frequencies required by Engineer to control dust for nuisance prevention to Owner, Engineer, and properties in the vicinity of the Site.

2. Dust control and cleaning measures shall be provided at no additional cost to the Owner.

3.02 NOISE CONTROL

A. Contractor's vehicles and equipment shall minimize noise emissions to greatest degree practicable. Provide mufflers, silencers, and sound barriers when necessary.

B. Noise levels shall comply with Laws and Regulations, including OSHA requirements and local ordinances.

C. Noise emissions shall not interfere with the work of Owner or others.

3.03 PEST AND RODENT CONTROL

A. Provide rodent and pest control as required to prevent infestation of the Site and storage areas.

B. Employ methods and use materials that do not adversely affect conditions at the Site or on adjoining properties.

C. In accordance with laws and regulations, promptly and properly dispose of pests and rodents trapped or otherwise controlled.

3.04 POLLUTION CONTROL

A. General:

1. Provide means, methods, and facilities required to prevent contamination of soil, water, and atmosphere caused by discharge of noxious substances from construction operations.

2. Equipment used during construction shall comply with Laws and Regulations.

B. Spills and Contamination:

1. Provide equipment and personnel to perform emergency measures required to contain spills and to remove contaminated soils and liquids.

2. Excavate contaminated material and properly dispose of off-site, and replace with suitable compacted fill and topsoil.

C. Protection of Surface Waters: Implement special measures to prevent harmful substances from entering surface waters. Prevent disposal of wastes, effluents, chemicals, and other such substances in or adjacent to surface waters and open drainage routes, in sanitary sewers, or in storm sewers.

D. Atmospheric Pollutants:

1. Provide systems for controlling atmospheric pollutants related to the Work.

2. Prevent toxic concentrations of chemicals and vapors.

3. Prevent harmful dispersal of pollutants into atmosphere.

E. Solid Waste:

1. Provide systems for controlling and managing solid waste related to the Work.

2. Prevent solid waste from becoming airborne, and from discharging to surface waters and drainage routes.

3. Properly handle and dispose of solid waste.

END OF SECTION

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SECTION 01 65 00

PRODUCT DELIVERY REQUIREMENTS

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes:

1. General requirements for preparing for shipping, delivering, and handling materials and equipment.

2. Contractor shall make all arrangements for transporting, delivering, and handling of materials and equipment required for prosecution and completion of the Work.

1.02 SUBMITTALS

A. Refer to individual Specification Sections for submittal requirements relative to delivery and handling materials and equipment.

1.03 SHIPMENT REQUIREMENTS

A. When practical, factory-assemble materials and equipment. Match mark or tag separate parts and assemblies to facilitate field assembly. Cover machined and unpainted parts that may be damaged by the elements with strippable, protective coating.

B. Package materials and equipment to facilitate handling, and protect materials and equipment from damage during shipping, handling, and storage. Mark or tag outside of each package or crate to indicate the associated purchase order number, bill of lading number, contents by name, Owner's contract name and number, Contractor name, equipment number, and approximate weight. Include complete packing lists and bills of materials with each shipment.

C. Protect materials and equipment from exposure to the elements and keep thoroughly dry and dust-free at all times. Protect painted surfaces against impact, abrasion, discoloration, and other damage. Lubricate bearings and other items requiring lubrication in accordance with manufacturer's instructions.

D. Advance Notice of Shipments:

1. Keep Engineer informed of delivery of all materials and equipment to be incorporated in the Work.

E. Do not ship materials and equipment until:

1. Related Shop Drawings, Samples, and other submittals have been approved or accepted (as applicable) by Engineer, including, but not necessarily limited to, Submittals associated with the materials and equipment being delivered.

2. Manufacturer's instructions for handling, storing, and installing the associated materials and equipment have been submitted to and accepted by Engineer in accordance with the Specifications.

3. Results of source quality control testing (factory testing), when required by the Contract Documents for the associated materials or equipment, have been reviewed and accepted by Engineer.

4. Facilities required for handling materials and equipment in accordance with manufacturer's instructions are in place and available.

5. Required storage facilities have been provided.

1.04 DELIVERY REQUIREMENTS

A. Scheduling and Timing of Deliveries:

1. Arrange deliveries of materials and equipment in accordance with the accepted Progress Schedule and in ample time to facilitate inspection prior to installation.

    a. Equipment and material shall not be delivered to the Site prior to 90 days in advance of scheduled installation.

    b. Partial payment requests will not be processed for materials delivered prior to 90 days before installation or for materials that are improperly stored.

2. Schedule deliveries to minimize space required for and duration of storage of materials and equipment at the Site or delivery location, as applicable.

3. Coordinate deliveries to avoid conflicting with the Work and conditions at Site, and to accommodate the following:

    a. Work of other contractors and Owner.

    b. Owner's operations and maintenance.

    c. Storage space limitations.

    d. Availability of equipment and personnel for handling materials and equipment.

    e. Owner's use of premises.

4. Deliver materials and equipment to the Site during regular working hours.

5. Deliver materials and equipment to avoid delaying the Work and the Project, including work of other contractors, as applicable. Deliver anchor system materials, including anchor bolts to be embedded in concrete or masonry, in ample time to avoid delaying the Work.

B. Deliveries:

1. Shipments shall be delivered with Contractor's name, Subcontractor's name (if applicable), Site name, Project name, and contract designation clearly marked.

2. Site may be listed as the "ship to" or "delivery" address; but Owner shall not be listed as recipient of shipment unless otherwise directed in writing by Engineer.

3. Provide Contractor's telephone number to shipper; do not provide Owner's telephone number.

4. Arrange for deliveries while Contractor's personnel are at the Site. Contractor shall receive and coordinate shipments upon delivery. Shipments delivered to the Site when Contractor is not present will be refused by Owner, and Contractor shall be responsible for the associated delays and additional costs, if incurred.

C. Containers and Marking:

1. Have materials and equipment delivered in manufacturer's original, unopened, labeled containers.

2. Clearly mark partial deliveries of component parts of materials and equipment to identify materials and equipment, to allow easy accumulation of parts, and to facilitate assembly.

D. Inspection of Deliveries:

1. Immediately upon delivery, Contractor shall inspect shipment to verify that:

a. Materials and equipment comply with the Contract Documents and approved or accepted (as applicable) submittals.

b. Quantities are correct.

c. Materials and equipment are undamaged.

d. Containers and packages are intact and labels are legible.

e. Materials and equipment are properly protected.

2. Promptly remove damaged materials and equipment from the Site and expedite delivery of new, undamaged materials and equipment, and remedy incomplete or lost materials and equipment to furnish materials and equipment in accordance with the Contract Documents, to avoid delaying progress of the Work.

3. Advise Engineer in writing when damaged, incomplete, or defective materials and equipment are delivered, and advise Engineer of the associated impact on the Progress Schedule.

1.05 HANDLING REQUIREMENTS

A. Provide equipment and personnel necessary to handle materials and equipment, including those furnished by Owner, by methods that prevent soiling or damaging materials and equipment and packaging.

B. Provide additional protection during handling as necessary to prevent scraping, marring, and otherwise damaging materials and equipment and surrounding surfaces.

C. Handle materials and equipment by methods that prevent bending and overstressing.

D. Lift heavy components only at designated lifting points.

E. Handle materials and equipment in safe manner and as recommended by the manufacturer to prevent damage. Do not drop, roll, or skid materials and equipment off delivery vehicles or at other times during handling. Hand-carry or use suitable handling equipment.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01 66 00
PRODUCT STORAGE AND PROTECTION REQUIREMENTS

PART 1 – GENERAL

1.01 SUMMARY

A. General requirements of storing and protecting equipment and materials.

1.02 STORAGE

A. Store and protect materials and equipment in accordance with manufacturer's recommendations and the Contract Documents.

B. Contractor shall make all arrangements and provisions necessary for, and pay all costs for, storing materials and equipment. Construction equipment, and materials and equipment to be incorporated into the Work shall be placed to avoid injuring the Work and existing facilities and property, and so that free access is maintained at all times to all parts of the Work and to public utility installations in vicinity of the Work. Store materials and equipment neatly and compactly in locations that cause minimum inconvenience to Owner, other contractors, public travel, and owners, tenants, and occupants of adjoining property. Arrange storage in manner to allow easy access for inspection.

C. Store materials and equipment to become Owner's property to facilitate their inspection and ensure preservation of quality and fitness of the Work, including proper protection against damage by freezing, moisture, and high ambient temperatures. Store in indoor, climate-controlled storage areas all materials and equipment subject to damage by moisture, humidity, heat, cold, and other elements, unless otherwise acceptable to Owner.

D. Contractor shall be fully responsible for loss or damage (including theft) to stored materials and equipment.

E. Do not open manufacturer's containers until time of installation, unless recommended by the manufacturer, directed by Engineer or otherwise specified in the Contract Documents.

F. Do not store materials or equipment in structures being constructed unless approved by Engineer in writing.

G. Do not use lawns or other private property for storage without written permission of the owner or other person in possession or control of such premises.

H. Contractor shall not store unnecessary equipment and materials at the Site.

I. Contractor shall prevent structures from being loaded with a weight that endanger its security and/or safety of persons.

J. Stored equipment and materials shall not be placed within 10 feet of fire hydrants.

K. Gutters, drainage channels and inlets shall be kept unobstructed at all times.

1.03 PROTECTION

A. Contractor shall provide temporary storage containers/facilities, if required, to protect equipment and materials at the Site.

B. Equipment to be incorporated into the Work shall be boxed, crated, or otherwise completely enclosed and protected during shipping, handling, and storage, in accordance with Section 01 65 00 – Product Delivery Requirements.

C. Store all materials and equipment off the ground (or floor) on raised supports such as skids or pallets.

D. Protect painted surfaces against impact, abrasion, discoloration, and other damage. Painted equipment surfaces that are damaged or marred shall be repainted in their entirety in accordance with equipment manufacturer and paint manufacturer requirements, to the satisfaction of Engineer.

1.04 SPECIFIC STORAGE REQUIREMENTS

A. Uncovered:

1. The following types of materials may be stored outdoors without cover on supports so there is no contact with the ground:

a. Piping, except polyvinyl chloride (PVC) or chlorinated PVC (CPVC) pipe.

B. Covered:

1. The following materials and equipment may be stored outdoors on supports and completely covered with covering impervious to water:

a. Grout and mortar materials.

b. Rough lumber.

c. PVC and CPVC pipe.

2. Tie down covers with rope, and slope covering to prevent accumulation of water.

C. Fully Protected:

1. All materials and equipment not named as uncovered or covered in this Section, shall be stored on supports in buildings or trailers that have concrete or wooden flooring, roof, and fully closed walls on all sides. Covering with plastic sheeting or similar material in space without floor, roof, and walls is not acceptable. Comply with the following:

    a. Provide heated storage for materials and equipment that could be damaged by low temperatures or freezing.

    b. Provide air-conditioned storage for materials and equipment that could be damaged by high temperatures.

    c. Protect mechanical and electrical equipment from being contaminated by dust, dirt, and moisture.

    d. Maintain humidity at levels recommended by manufacturers of electrical and electronic equipment.

    e. Energize space heaters for electrical equipment and material.

D. Maintenance of Storage: On scheduled basis, periodically inspect stored materials and equipment to ensure that:

    1. Condition and status of storage facilities is adequate to provide required storage conditions.

    2. Required environmental conditions are maintained on continuing basis.

    3. Materials and equipment exposed to elements are not adversely affected.

1.05 RECORDS

A. Keep up-to-date account of materials and equipment in storage to facilitate preparation of Applications for Payment, if the Contract Documents provide for payment for materials and equipment not incorporated in the Work but delivered and suitably stored at the Site or at another location agreed to in writing.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

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SECTION 01 71 23
FIELD ENGINEERING

PART 1 – GENERAL

1.01 SUMMARY

A. Contractor shall provide field engineering and professional services of the types indicated for the Project, including:

1. Furnishing civil, structural, and other professional engineering services specified or required to execute Contractor's construction methods.

2. Developing and making all detail surveys and measurements required for construction.

3. Keeping a transit, theodolite, or total station (theodolite with electronic distance measurement device); leveling instrument; and related implements such as survey rods and other measurement devices, at the Site at all times, and having a skilled instrument person available when necessary for laying out the Work.

4. Being solely responsible for all locations, dimensions and levels. No data other than Change Order, Work Change Directive, or Field Order shall justify departure from dimensions and levels required by the Contract Documents.

5. Rectifying all Work improperly installed because of not maintaining, not protecting, or removing without authorization established reference points, stakes, marks, and monuments.

6. Providing such facilities and assistance necessary for Engineer to check lines and grade points placed by Contractor.

B. Related Sections:

1. Section 01 25 00 – Substitution Procedures

2. Section 01 26 00 – Contract Modification Procedures

3. Section 01 61 00 – Product Requirements and Options

4. Section 01 78 39 – Project Record Documents

1.02 ADMINSTRATIVE REQUIREMENTS

A. Departures from Contract Drawings:

1. Contract Drawings show the extent and arrangement of the Work.

2. Contractor shall notify Engineer of departures from the Drawings that the Contractor deems required for incorporation of the Work at the Site in accordance with Section 01 26 00 – Contract Modification Procedures.

3. Contractor shall provide field engineering services for equipment and materials that require modifications to existing structures, auxiliary equipment, piping, electrical controls that are not indicated for modifications in the Contract Documents.

B. Structural Design Criteria:

1. Structural design in the Contract Documents of facilities, structures, supports, roofs and floors are based on typical weights for equipment and materials and design criteria in the Contract Documents.

2. Contractor shall notify Engineer of equipment and materials to be considered as substitutions and “or equals” in accordance with Section 01 25 00 – Substitution Procedures and Section 01 61 00 – Product Requirements and Options.

3. Contractor shall provide services for incorporation of equipment and materials that exceed structural design criteria at no additional cost to Owner.

1.03 SERVICES AND RESPONSIBILITIES

A. Contractor’s Field Engineer:

1. Contractor shall employ and retain field engineer at the Site capable of performing field engineering tasks required, including:

a. Provide reports to Engineer on the Work.

b. Check formwork, reinforcing, inserts, structural steel, bolts, sleeves, piping and other equipment and materials for conformance with Contract Documents.

c. Maintain field office files and drawings, record documents, and coordination with Subcontractors.

d. Prepare layout and coordination drawings for construction operations.

e. Check and coordinate Work for conflicts, interferences, and discrepancies with notification to Engineer.

f. Cooperate with Engineer and Owner in observing the Work and field inspections.

g. Review and coordinate the Work with Shop Drawings and other submittals.

B. Contractor’s Surveyor:

1. Contractor shall employ or retain the services, as needed, at the Site a surveyor with experience and capability of performing surveying and layout tasks required in the Contract Documents and as required for the Work. Surveyor's tasks include, but are not necessarily limited to, the following:

a. Providing required surveying equipment, including transit or theodolite, level, stakes, and surveying accessories.

b. Establishing required lines for constructing all facilities, structures, pipelines, and site improvements.

c. Preparing and maintaining professional-quality, accurate, well organized, legible notes of all measurements and calculations made while surveying and laying out the Work.

d. Prepare elevation certificates as required to confirm finished floor elevations for the Hypochlorite Tank Storage structure in compliance with Flood Hazard Documentation requirements.

e. Complying with requirements of the Contract Documents relative to surveying and related work.

1.04 SUBMITTALS

A. Action/Informational Submittals:

1. Surveying:

a. Plan for conducting survey Work, submitted ten days prior to beginning of survey Work.

b. Field books after completing survey Work.

c. Certified survey in accordance with this Section.

2. Certificates: Signed Contractor or Contractor’s surveyor certifying elevations and locations of Work are in conformance with Contract Documents, with explanations of deviations.

3. Qualification Statements: Contractor’s surveyor.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.01 SURVEYING

A. Contractor shall establish baselines for location of equipment, materials and structures of the Work with bench marks and batter boards adjacent to Work.

B. Contractor shall provide detailed surveys necessary for the Work including, but not limited to, slope stakes, batter boards, working points, lines and elevations.

C. Specific surveying:

1. Contractor shall have weirs surveyed by professional, licensed surveyor.

2. Contractor shall adjust weirs within a tolerance of +/- 0.05-inches of elevations shown on the Contract Documents.

3. Surveyed points for weirs shall be no greater than 10-feet spacing, and no less than two points per section of weir plate.

3.02 CLOSEOUT ACTIVITES

A. Contractor shall provide Project record documents for field engineering and surveying in accordance with Section 01 78 39 – Project Record Documents.

B. Contractor shall provide certified weir elevation survey report in accordance with the requirements specified in this Section.

3.03 PROTECTION

A. Contractor shall preserve and protect bench marks, reference points and stakes. Contractor shall re-establish damaged, destroyed, or lost bench marks, reference points and stakes. Contractor shall remove and re-install equipment and material installed based on Contractor established bench marks, reference points and stakes that have been damaged, destroyed, or lost at no additional cost to Owner.

B. Contractor shall preserve and protect existing and new control points, property markers and monuments during construction of the Work. Contractor shall establish and replace damaged or lost control points, property markers and monuments due to Contractor's construction activities at no cost to the Owner. Contractor shall provide computations and calculations to establish location of replacement Work.

END OF SECTION

SECTION 01 71 33

PROTECTION OF WORK AND PROPERTY

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes:

1. Protection of existing utilities and structures.

2. Protection of installed equipment and materials.

3. Protection during inclement weather.

4. Reporting of accidents.

5. Barricades and warning signals.

B. Contractor shall be responsible for taking all precautions, providing all programs, and taking all actions necessary to protect the Work and all public and private property and facilities from damage, as specified in the General Conditions, Supplementary Conditions, and this Section.

C. To prevent damage, injury, or loss, Contractor's actions shall include the following:

1. Storing apparatus, materials, supplies, and equipment in an orderly, safe manner that does not unduly interfere with progress of the Work or work of other contractors or utility companies.

2. Providing suitable storage facilities for equipment and materials subject to damage or degradation by exposure to weather, theft, breakage, or other cause.

3. Placing upon the Work or any part thereof only loads consistent with the safety and integrity of that portion of the Work and existing construction.

4. Frequently removing and disposing of refuse, rubbish, scrap materials, and debris caused by Contractor's operations so that, at all times, the Site is safe, orderly, and workmanlike in appearance.

D. Contractor has full responsibility for preserving public and private property and facilities on and adjacent to the Site. Direct or indirect damage done by, or on account of, any act, omission, neglect, or misconduct by Contractor in executing the Work, shall be restored by Contractor, at their expense to condition equal to that existing before damage was done.

E. Contractor shall comply with safety regulations required by Owner or authorities having jurisdiction. Contractor shall comply with and correct unsafe conditions created or caused by Contractor's personnel. In the event Contractor fails to comply, Owner receives the right to take necessary measures to correct conditions or practices for reimbursement by Contractor.

1.02 REFERENCES

A. Definitions:

1. "Existing utilities" shall refer to both publicly-owned and privately-owned utilities such as, but are not limited to, electric power and lighting, telephone, water, gas, storm drains, process lines, sanitary sewers and all appurtenant structures.

2. "Surface structures" are existing buildings, structures, and other facilities at or above ground surface, including their foundations or any extension below ground surface. Surface structures include, but are not limited to, buildings, tanks, walls, channels, open drainage, exposed piping and utilities, poles, exposed wires, posts, signs, markers, curbs, walks, fencing, and other facilities visible at or above ground surface.

1.03 SITE CONDITIONS

A. Location of Existing Utilities and Structures:

1. Contractor shall confirm and verify location of existing utilities and structures at the Site prior to commencing the Work.

2. Contractor shall notify and obtain approval from authority having jurisdiction prior to performing the Work in the vicinity of the existing utilities and structures.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.01 PROTECTION OF EXISTING UTILITIES AND STRUCTURES

A. General:

1. Contractor shall satisfy Engineer that methods and procedures for protection have been approved by authorities having jurisdiction prior to proceeding with the Work.

2. Contractor shall provide temporary support and protection, as required, to existing utilities and structures during the Work, including support of excavation.

a. Temporary support and protection of existing utilities shall be provided in accordance with requirements of the authority having jurisdiction.

b. Temporary support and protection of existing structures shall be provided as required to ensure structural integrity is not compromised.

3. Contractor shall be responsible for costs incurred for temporary support or protection provided by a third-party or authority having jurisdiction to insure safety of the existing utility, Owner, and public and private parties.

B. Existing Buried Utilities:

1. Contractor shall perform field investigate to identify conflicts or interferences between existing utilities and utility Work prior to excavation Work.

a. Investigation of conflicts and interferences shall be performed on Site locations, elevations, slopes, etc. of the existing utilities determined during the field investigations.

b. Contractor shall notify Engineer and Owner in writing of identified conflicts or interferences. Contractor shall not proceed with the Work until written authorization is provided by the Engineer.

c. Identified conflicts and interferences shall be handled in accordance with the Contract Documents. If required, potential modification to the Contract Documents shall be performed in accordance with the Supplementary and General Conditions.

2. Contractor shall perform the Work to prevent disruption of existing service and damage to existing utilities.

a. Temporary connections shall be provided, as required, to provide un-interrupted service of existing utilities.

b. Contractor shall repair damage to existing utilities as directed by the Engineer or the authority having jurisdiction at Contractor’s own expense.

c. Contractor shall be responsible for damages and repair costs to the authority having jurisdiction if third-party or authority having jurisdiction personnel repair damaged existing utilities.

C. Protection of Existing Structures:

1. Contractor shall sustain existing surface structures in existing place and protect from direct or indirect injury located within or adjacent to the limits of the Work. Such sustaining and supporting shall be done carefully and as required by the party owning or controlling such structure or facility.

2. Contractor shall bear all risks attending the presence or proximity of all surface structures within or adjacent to limits of the Work, in accordance with the Contract Documents.

3. Contractor shall be responsible for damage and expense for direct or indirect injury caused by their Work to structures and facilities.

4. Contractor shall repair immediately damage caused by their Work, to the satisfaction of owner of damaged structure or facility at no cost to the Owner.

5. Contractor shall provide temporary weather protection for existing structures and buildings where exterior walls or roofs are modified or disturbed in the Work. Contractor shall be responsible for damages due to inadequate protection of existing structures and building.

D. Relocation of Surface Structures: Existing surface facilities, including but not limited to guard rails, posts, guard cables, signs, poles, markers, curbs, and fencing, that are temporarily removed to facilitate the Work shall be replaced and restored to their original condition at Contractor's expense.

3.02 PROTECTION OF INSTALLED EQUIPMENT AND MATERIALS

A. Contractor shall protect installed equipment and materials to prevent damage, injury or loss from subsequent operations. Remove protection facilities when no longer needed prior to completion of the Work.

B. Control traffic to prevent damage to equipment, materials, and surfaces.

C. Coverings: Provide coverings to protect materials and equipment from damage.

3.03 PROTECTION DURING INCLEMENT WEATHER

A. Contractor shall not perform Work during inclement or unsuitable weather that will affect the quality of the completed Work.

B. Contractor shall take necessary precautions in the event of impending inclement weather to protect equipment, materials and Work from damage or deterioration due to floods, driving rain, wind, or snow storms.

1. Owner reserves the right to require additional protection measures beyond Contractor's proposed protection measures to protect the Work.

2. Contractor shall not claim additional compensation for additional protection measures required by Owner nor for damages to equipment, material, or Work due to the inclement weather.

C. When directed by Engineer, Contractor shall stop Work and protect new Work by protective covering during rain storms for, but not limited to, the following:

1. Concrete mixing and placement.

2. Paving placement.

3. Masonry installation.

4. Buried piping, valve and appurtenance installation.

5. Additional inclement weather requirements and limitations are specified in individual Specification Sections.

3.04 REPORTING OF ACCIDENTS

A. Contractor shall immediately report, in writing, to Engineer and Owner accidents out of, or in conjunction with, the performance of Work.

1. Accident reporting includes on Site and adjacent to Site, which cause death, personal injury, or property damage.

2. Written report shall provide full details and witness statements.

3. If claim is made against Contractor, Supplier, or Subcontractor due to accident, Contractor shall promptly report facts, in writing, to Engineer and Owner, with full account of the claim.

B. Contractor shall immediately report death, serious injury, or serious damage caused by telephone or messenger to Engineer and Owner.

3.05 BARRICADES AND WARNING SIGNALS

A. General:

1. Where the Work is performed on or adjacent to roadway, access road, right-of-way, or public place:

a. Provide barricades, fences, lights, warning signs, danger signals, watchmen, and take other precautionary measures for protecting persons, property, and the Work.

b. Paint barricades to be visible at night.

c. From sunset to sunrise, furnish and maintain at least one light at each barricade.

d. Erect sufficient barricades to keep vehicles from being driven on or into Work under construction.

e. Furnish watchmen in sufficient numbers to protect the Work.

B. Provide temporary barricades to protect personnel and property for Work not in or adjacent to vehicular travel areas, including indoor work, in accordance with Laws and Regulations.

C. Contractor's responsibility for maintaining temporary barricades, signs, lights, and for providing watchmen shall continue until the Work is accepted in accordance with the Contract Documents.

END OF SECTION

SECTION 01 73 00

DEMOLITION AND EXECUTION OF WORK

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes:

1. Contractor shall provide labor, materials, tools, equipment, and incidentals shown, specified, and required for execution of the Work as specified in this Section, including the following:

    a. Construction Electronic Documentation

    b. Demolition

    c. Cutting and Coring

    d. Patching

    e. Installation

2. Requirements for demolition, removal and disposal of existing structures, pavement, curbs, and sidewalks, and electrical, plumbing, and materials as indicated in the Contract Documents for demolition.

3. General requirements for installation of equipment and material. Additional installation requirements are included in the individual Specification Sections.

4. General requirements for connections to existing facilities. Requirements for tie-ins and shutdowns necessary to complete the Work are included in Section 01 14 00 – Coordination with Owner's Operations.

    a. To extent possible, materials, equipment, systems, piping, and appurtenances that will be placed into service upon completion of connection to existing facilities shall be checked, successfully tested, and in condition for operation prior to making connections to existing facilities, if valves, gates, or similar watertight and gastight isolation devices are not provided at the connection point.

5. Requirements for cutting and coring, and rough and finish patching of holes and openings in existing construction. Provide cutting, coring, fitting, and patching, including attendant excavation and fill, required to complete the Work, and to:

    a. Remove and replace defective Work.

b. Remove samples of installed Work as specified or required for testing.

c. Remove construction required to perform required alterations or additions to existing work.

d. Connect to completed Work not performed in proper sequence.

e. Remove or relocate existing utilities and pipes that obstruct the Work in locations where connections must be made.

f. Make connections or alterations to existing or new facilities.

B. Related Sections:

1. Section 01 14 00 – Coordination with Owner's Operations

2. Section 01 51 00 – Temporary Utilities

3. Section 01 57 00 – Temporary Controls

4. Section 01 66 00 – Product Storage and Protection Requirements

5. Section 01 74 00 – Cleaning and Waste Management

6. Section 01 79 00 – Instruction of Owner's Personnel

7. Section 02 41 00 – Site Demolition

1.02 REFERENCES

A. Definitions:

1. "Manufacturer's installation instructions" includes manufacturer's written instructions; drawings; illustrative, wiring, and schematic diagrams; diagrams identifying external connections; and other such information pertaining to installation of equipment and materials. Installation instructions are printed instructions, including those attached to the equipment and materials, all inclusive.

2. "Salvage" items are equipment and materials shown on the Contract Documents for selective removal by the Contractor to furnish to the Owner. Contractor shall be responsible for removal, handling, and depositing of equipment and material to location designated by Owner.

B. Reference Standards:

1. 29 CFR 1910, OSHA.

2. ANSI A10, Construction and Demolition Operations

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Review installation procedures under other Sections and coordinate Work that must be performed with or before the Work specified in this Section.

2. Notify other contractors in advance of Work for connections to existing facilities to prevent delay of the Work.

3. Remove and dispose of equipment and materials indicated for demolition on the Contract Documents, unless indicated as salvage items for the Owner. Contractor shall obtain ownership of removed equipment and materials following Engineer and Owner approval. Disposal of equipment and materials shall be in accordance with the Contract Documents

B. Sequencing:

1. Contractor shall remove and demolish equipment and materials in sequence specified in Section 01 14 00 – Coordination with Owner's Operation and following approval by Engineer and Owner.

2. Contractor shall replace equipment and materials removed without proper authorization from Engineer, which are necessary for the operation of the existing facilities. Re-installation of equipment and materials shall be to the satisfaction of the Engineer at no cost to the Owner

C. Title to Equipment and Materials:

1. Equipment and materials indicated for demolition and removal in the Contract Documents, and not designated as Owner's salvaged items, shall become the Contractor's property following removal from the Site. Contractor shall be responsible for legally disposing of the equipment and material.

2. Contractor shall have no right or title to any of the equipment, materials, or other items to be removed until the elements have been removed from the Site.

3. Contractor shall not sell or assign or attempt to sell or assign any interest in the equipment, materials, or other items until removal from Site.

4. Contractor shall have no claim against the Owner because of the absence of equipment, fixtures, and materials.

D. Salvage Equipment and Materials:

1. Contract Documents indicate equipment and materials that shall be retained by Owner. Owner has the right to request any demolished equipment and materials be retained at their discretion.

2. Contractor shall move salvaged equipment and materials to storage areas located at the Southern Regional Wastewater Treatment Plant as instructed by Owner.

3. Architectural equipment and materials may be salvaged for incorporation into the Work when approved by Engineer.

E. Use of Explosives: Contractor shall not use explosives or blasting equipment and material in the Work in accordance with the Contract Documents.

1.04 SUBMITTALS

A. Action/Informational Submittals:

1. Construction electronic documentation as specified in this Section.

2. Demolition Plan: Submit detailed description of methods, equipment, and sequence for demolition Work, including means of ensuring stability of structures during demolition activities.

3. Cutting and Patching Request:

a. Submit written request to Engineer, well in advance of executing cutting or alteration that affects one or more of the following:

1) Design function or intent of Project.

2) Work of Owner or other contractors.

3) Structural value or integrity of an element of the Project.

4) Integrity or effectiveness of weather-exposed or moisture-resistant elements or systems.

5) Efficiency, operational life, maintenance, or safety of operational elements.

6) Visual qualities of sight-exposed elements.

b. Request shall include:

1) Identification of Project and contract name and number.

2) Description of affected Work of Contractor and work of others (if any).

3) Necessity for cutting.

4) Effect on work of Owner, other contractors (if any), and on structural or weatherproof integrity of Project.

5) Description of proposed Work, including scope of cutting and patching; trades who will be executing the Work; products proposed to be used; extent of refinishing; schedule of operations; alternatives to cutting and patching, if any.

6) Designation of entity responsible for cost of cutting and patching, when applicable.

7) Written permission of other contractors (if any) whose work will be impacted.

4. Recommendation Regarding Cutting and Patching:

a. Should conditions of work, or schedule, indicate a change of materials or methods, submit written recommendation to Engineer including:

1) Conditions indicating change.

2) Recommendations for alternative materials or methods.

3) Items required with substitution request, in accordance with the substitution request requirements of the Contract Documents and Section 01 61 00 – Product Requirements and Options.

5. Product Data: Submit manufacturer's product data for the protective compound to be applied to core-drilled surfaces and cut concrete surfaces, as well as means of protecting exposed reinforcement or other metal embedments.

6. Informational Submittal: Submit written indication designating the day and time that the construction associated with cutting and patching will be uncovered, to allow observation. Do not begin cutting or patching operations until submittal is accepted by Engineer.

7. Comply with submittal requirements of individual Specification Sections for patching materials.

1.05 SITE CONDITIONS

A. Owner does not assume responsibility for the actual condition of structures and equipment to be demolished and removed.

B. Existing Site conditions shall be maintained to the greatest extent possible by the Owner to the time of Notice to Proceed.

C. Contractor shall perform investigations, explorations, and probes as necessary at the Site prior to initiating demolition Work to ascertain any required protective measures before proceeding with demolition and removal. Contractor shall give particular attention to shoring and bracing requirements to prevent damage to the Work and existing structures.

D. Contractor shall verify measurements, dimensions and other conditions of each existing structure, system, equipment, and material indicated in the Contract Documents for new Work prior to ordering equipment and materials.

PART 2 – PRODUCTS

2.01 MATERIALS

A. General:

1. Provide materials and products in accordance with the individual Specification Sections and the Contract Documents.

2. Provide materials and products that visually match existing adjacent surfaces to fullest extent possible for exposed surfaces.

3. If not indicated in the Contract Documents, provide materials and products that are identical to existing materials and products affected by the Work.

4. If identical materials and products are unavailable, provide materials and products that shall equal or exceed performance requirements of existing materials and products.

B. Protective Coating Applied to Core-Drilled Surfaces and Cut Concrete Surfaces:

1. All concrete surfaces exposed due to cutting or core drilling shall be coated with an epoxy resin coating such as Sikagard 62 by Sika Corporation, Durakote 240 by Tamms Industries or approved equal.

2. Reinforcement or other metal embedment exposed by concrete cutting or core drilling shall be burned back a minimum of ½ inch below surface and resulting void shall be filled with an epoxy resin binder.

PART 3 – EXECUTION

3.01 CONSTRUCTION ELECTRONIC DOCUMENTATION

A. Pre-Construction Documentation

1. Contractor shall take photographic and video documentation of the Site where Work is being performed. Engineer and Owner reserve the right to be present during documentation.

2. Contractor shall provide both photographic and video documentation at grade-level of the Site prior to commencement of Work.

3. Contractor shall submit pre-construction documentation to Engineer and Owner for review. Contractor, Engineer, and Owner shall visit Site to field verify electronic documentation prior to commencing the Work. Site visit verification shall establish existing conditions prior to commencing Work.

B. Construction Progress Documentation

1. Contractor shall document Work progress at locations and construction as directed by Engineer, at a minimum.

2. Contractor shall provide electronic documentation prior to and following any shutdown, switchover, demolition, de-commissioning, cutting, patching, repair, etc. Engineer and Owner reserve the right to be present during documentation.

3. Contractor shall document following exposure of buried utilities, piping, valve, appurtenances, and other underground elements.

4. Engineer reserves the right to provide construction progress documentation to confirm Contractor electronic documentation.

C. Post-Construction Documentation

1. Contractor shall take photographic and video documentation of the Site where Work has been completed and prior to Substantial Completion or partial utilization by Owner. Engineer and Owner reserve the right to be present during documentation.

2. Contractor shall provide both photographic and video documentation at grade-level and aerial of the Site following completion of the Work.

D. Submittal Requirements:

1. Documentation shall be time stamped for verification, including date and time.

2. Documentation shall be organized in a logical manner, such as by structure, building, physical site location, etc. for easy of comparison.

3. Photographic documentation shall be high resolution electronic versions.

4. Documentation shall be submitted to Engineer for review and approval prior to commence Work and at completion of the Work.

3.02 DEMOLITION

A. General:

1. Demolition Work shall comply with the applicable provisions and recommendation of ANSI A10, Construction and Demolition Operations standards, all governing codes, and as specified in this Section.

2. Contractor shall furnish competent and experienced personnel for the various type of demolition and removal Work. Demolition and removal Work shall be performed with regard to the safety of Owner employees, individuals at the Site, and the public.

3. Contractor shall confirm absence of embedded utilities prior to cutting, coring, or demolishing existing concrete and facilities. Verification shall be performed by portable x-ray, ground penetrating radar, or other non-invasive methods.

   a. Contractor shall notify Engineer and Owner if embedded utilities are located during the investigation. Contractor shall clearly mark and document location of embedded utilities prior to performing the Work.

   b. Contractor shall be responsible for repair and damages caused by exploration, investigation, and performance of the Work at no additional cost to Owner.

4. Contractor shall remove temporary work, such as enclosures, signs, guards, etc. when such temporary Work is no longer required or when directed at the completion of the Work.

5. Contractor shall perform patching, restoration and Work in accordance with individual Specification Sections and details shown on Contract drawings.

6. Contractor shall be responsible for damage caused by demolition Work to existing structures, equipment and materials indicated for reuse or to remain at no additional cost to Owner.

7. Contractor shall maintain a clean working environment during the demolition Work in accordance with Section 01 74 00 – Cleaning and Waste Management.

8. Contractor shall proceed with the demolition work in a sequence designed to maintain the plant in operation in accordance with Section 01 14 00 – Coordination with Owner's Operations.

9. Excavation caused by demolition shall be backfilled with fill free from rubbish and debris. Select fill or structural fill shall be used where specifically required on Contract Drawings.

10. All debris resulting from the demolition and removal work shall be disposed of by the Contractor at a properly permitted facility as part of the work of this Contract. All regulations covering material handling and disposal shall be followed. Material designated by the Engineer to be salvaged shall be stored on the construction site as directed. All other material shall be disposed of off-site by the Contractor at his expense. Burning of any debris resulting from the demolition will not be permitted at the site.

B. Protection during Demolition:

1. Contractor shall provide, erect, and maintain catch platforms, lights, barriers, weather protection, warning signs and other items as required for proper protection of the public, occupants of the building, personnel engaged in demolition Work, and adjacent construction.

2. Contractor shall provide and maintain weather protection at exterior openings to fully protect the interior premises against damage from the elements until such openings are closed by the Work.

3. Contractor shall provide and maintain temporary protection of the existing structure designated to remain where demolition, removal and Work is being done, connections made, materials handled, or equipment moved. Temporary protection shall be provided in accordance with Section 01 71 33 – Protection of Work and Property.

4. Contractor shall take necessary precautions to prevent dust from rising by wetting demolished masonry, concrete, plaster, and similar debris. Unaltered portions of the existing buildings affected by the operations in the Contract Documents shall be protected by dust proof partitions and other adequate means. Dust control shall be provided in accordance with Section 01 57 00 – Temporary Controls.

5. Contractor shall provide adequate fire protection in accordance with Section 01 51 00 – Temporary Utilities and authorities having jurisdiction.

6. Contractor shall perform the demolition Work with minimum traffic interference. Contractor shall not close or obstruct walkways, passageways, or stairways. Contractor shall not store or place materials in passageways, stairs, or other means of egress.

7. Contractor shall minimize disturbances to exterior walls and roofs to small sections that are readily repaired and patched to maintain watertight conditions in existing structures and buildings.

C. Performance of Demolition:

1. Equipment, piping, valves, and appurtenances:

a. Contractor shall drain equipment, piping, valves, and appurtenances prior to demolition Work. Contractor shall be responsible for collection, transport, and disposal of drained contents at no additional cost to the Owner.

b. Contractor shall provide line stops, plugs, blind flanges, etc. for equipment, piping, valves, and appurtenance required to remain in service during the Project. Contractor shall provide temporary or permanent supports in accordance with the Contract Documents.

c. Supports, pedestals and anchors shall be removed with the equipment and piping unless otherwise noted in the Contract Documents.

d. Concrete bases, anchor bolts and other supports shall be removed to approximately 1 inch below the surrounding finished area and the recesses shall be filled with epoxy resin binder.

e. Wall and roof openings shall be closed, and damaged surfaces shall be patched to match the adjacent areas, in accordance with the Contract Documents and as directed by the Engineer.

f. Wall sleeves, wall pipes, and wall castings shall be plugged or blanked off in accordance with the Contract Documents and as directed by the Engineer.

g. Openings in concrete shall be closed in accordance with the Contract Documents and as directed by the Engineer.

2. Electrical components and equipment:

a. Contractor shall de-energize panelboards, lighting fixtures, switches, circuit breakers, electrical conduits, motors, limit switches, pressure switches, instrumentation such as flow, level and/or other meters, wiring, and similar electrical equipment prior to removal.

b. Contractor shall relocate or isolate electrical equipment and materials that serve equipment, piping, valves, and appurtenance that are to remain in service during the Project. Relocation or isolation Work shall be sequenced and scheduled in accordance with Section 01 14 00 – Coordination with Owner’s Operations.

3. Reused and relocated equipment:

    a. Contractor shall receive approval from Engineer prior to removal and relocation of equipment and material. Equipment and materials removed by Contractor prior to Engineer's approval that is required for Owner's operation of the facility shall be reinstalled at no cost to the Owner.

    b. Prior to removal and relocation Work, equipment and materials indicated for reuse and relocation shall be operated by Owner with Contractor and Engineer present to witness existing functionality and operation.

    c. Contractor shall provide personnel responsible for reinstallation of equipment and material for the removal Work.

    d. Contractor shall be responsible and provide storage and protection of equipment and materials in accordance with Section 01 66 00 – Product Storage and Protection Requirements until relocation and reinstallation Work is performed.

    e. Contractor shall provide replacement equipment and material that is damaged during the removal Work at new cost to the Owner. Contractor shall be responsible to provide same type, model, electrical components, etc. equipment and material as approved by Engineer and Owner.

4. Structural removal:

    a. Contractor shall provide and install temporary shoring, struts, and bracing required for the demolition Work to ensure stability during entire demolition process.

    b. Contractor shall cut and remove structural material at the interface of demolition Work and the existing structural element. Cutting and removal shall occur in small sections, including masonry units, to prevent instability of structural elements.

    c. Contractor shall patch, repair, and refinish adjacent surfaces that remain following demolition Work.

        1) Adjacent surfaces shall be repaired and refinished to the condition prior to the demolition Work and in accordance with the Contract Documents.

        2) Adjacent surfaces shall be cleaned of dirt, grease, loose paint, etc., prior to refinishing.

    d. Contractor shall limit cutting of existing roof areas designated to remain to the limits required for the proper installation of the Work.

1) Cut and remove insulation, joists, flashing, membranes, shingles, and metals, etc. in accordance with the Contract Documents and as directed by the Engineer for installation of the Work.

2) Provide temporary weather tight protection as required until new roofing and flashings are installed.

5. Architectural repairs and removal Work, not specifically shown on the Drawings, may include, but not limited to, the following:

a. Brickwork: Re-pointing; removing and replacing broken, cracked, disintegrating and missing materials.

b. Windows: Removing cracked or disintegrating sealant material; replacing missing or broken glass; re-caulking and sealing frames; glazing sealants.

c. Re-finishing: Removing rust, sealing, or peeling paint from surfaces by scraping, sanding or wire brushing; priming and repainting surfaces.

d. Roofing: Patching and repairing membrane or built-up roofing; metal flashing repair; correcting roof pitch to eliminate ponding; cleaning and/or replacing roof drains.

e. Masonry: Cutting and installing new expansion and control joints.

f. Parapets: Removing and construction of new walls and copings; clean and patching of copings; replacing copings where broken.

g. Concrete surfaces: Patching, cleaning, sealing and resurfacing floors, walls, lintels, sills, and trim. Replace lintels where broken. Patching or replacing broken, spalled, cracked and disintegrating concrete encased steel columns and piers.

h. Openings: Cutting and modifying as required for new Work. Provide new lintels, doors, and frames.

i. Doors: Patching and refinishing doors and frames.

j. Ceilings: Patching, refinishing, and replacing.

k. Guards, handrails, and appurtenances: Cleaning and repainting steel materials. Replacing steel material with new aluminum material.

l. Demolished Exterior Openings: Remove window sash, frame, sill, stool and trim at exterior doors indicated for enclosure and sealing. Provide brick and/or masonry block for closure and sealing.

D. Maintenance during Demolition:

1. Contractor shall maintain the buildings, structures, and public properties free from accumulations of waste, debris and rubbish, generated by the demolition Work.

2. Contractor shall provide cleaning and waste management of demolition equipment and materials in accordance with Section 01 74 00 – Cleaning and Waste Management.

3.03 CUTTING AND CORING

A. General:

1. Contractor shall notify Engineer in writing and receiving Engineer's approval prior to cutting load bearing walls (concrete or masonry) and structural concrete floors.

2. Perform cutting and coring to limit extent of patching required.

3. Structural Elements: Do not cut or core structural elements in manner that would change structural element's load-carrying capacity or load deflection ratio.

4. Operating Elements: Do not cut or core operating elements in manner that would reduce capacity to perform as intended. Do not cut or core operating elements or related components in manner that would increase maintenance requirements or decrease operational life or safety.

5. Replace, patch, and repair materials and surfaces cut or damaged during cutting and coring Work. Contractor shall use methods that do not void required or existing warranties.

6. Provide temporary or permanent bypass provisions prior to cutting existing pipe, conduit, ductwork, or other utilities serving facilities scheduled to be removed or relocated in accordance with the Contract Documents.

7. Inspection: Examine and prepare surfaces prior to commencing Work. Contractor shall report unsatisfactory or questionable conditions to Engineer in writing. Contractor shall not proceed with the Work until unsatisfactory conditions are corrected.

8. Preparation:

a. Provide temporary support required to maintain structural integrity, to protect adjacent Work from damage, and to support the element(s) to be cut or cored.

b. Protection of Existing Construction During Cutting and Coring:

1) Protect existing structures, equipment, and materials during cutting and coring to prevent damage.

2) Provide protection from adverse weather conditions that will be exposed during cutting and coring Work.

3) Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.

9. Restoration:

a. Clean equipment, materials, piping systems, valves, conduit and appurtenances that were damaged due to the Work prior to applying paint or other finishing materials.

b. Restore damaged pipe coverings, including insulation, to original condition.

B. Cutting:

1. General:

a. Cut existing structures and appurtenances that provide surfaces for installation or repair of the Work. Cut existing construction using methods to minimize damage and disturbance to retained and adjoining construction elements.

b. Cutting equipment used shall be hand or small power tools suitable for sawing or grinding. Avoid using hammering or chopping equipment for cutting Work.

c. Cut holes and slots as small as possible and to size required for incorporation of the Work and in accordance with the Contract Documents.

d. Cut or drill from exposed or finished side to concealed side to avoid marring finished surfaces.

e. Provide adequate bracing of area to be cut prior to cutting.

f. Provide equipment and material to remove cut spoils.

g. Provide temporary protection for cut openings where and when Work is not being performed.

2. Concrete and Masonry:

a. Cut through concrete and masonry using concrete wall saw with diamond saw blades.

b. Provide control for slurry generated during sawing on both sides of element being cut.

c. After cutting concrete and before installing new Work on or through the opening, coat exposed concrete and steel with protective coating material specified in this Section. Apply protective coating in accordance with manufacturer's instructions.

C. Coring:

1. Core-drill holes through concrete and masonry walls, slabs, or arches, in accordance with the Contract Documents, unless written authorization is furnished by Engineer.

2. Protection: Protect existing structures, equipment, materials, utilities, and adjacent areas from water and other damage by core-drilling Work.

3. Coring:

a. Perform coring with non-impact rotary tool using diamond core-drills.

b. Size holes for pipe, conduit, sleeves, equipment, or mechanical seals, as required, to be installed through the penetration and in accordance with the Contract Documents.

c. After core-drilling and before installing equipment and material through the penetration, coat exposed concrete and steel with protective coating material specified in this Section. Apply protective coating in accordance with manufacturer's instructions.

4. Cleaning: Vacuum or otherwise remove slurry and tailings from the work area following core-drilling.

3.04 PATCHING

A. General:

1. Construction shall be patched by filling, repairing, refinishing, closing-up, and similar methods at completion of the Work.

2. Provide equipment and materials in accordance with the Contract Documents for patching Work. Comply with manufacturer's installation instructions.

3. Provide airtight connections to pipes, sleeves, ducts, conduit, and other penetrations through surfaces when patching the Work. Provide durable patching seams that minimize visual appearance.

4. Patched areas shall be tested to demonstrate integrity of installation as directed by the Engineer. Contractor shall provide testing equipment, material, and services for patch testing.

B. Restoration:

1. Restore exposed finishes of patched areas to minimize evidence of patching and refinishing.

2. Contractor shall extend refinishing and restoration into adjoining areas to blend patched areas with existing adjacent areas.

a. Refinish to nearest intersection for continuous surfaces.

b. Refinish the entire assembly and system for equipment and materials.

c. Repair and rehang existing ceilings to provide an even-plane surface of uniform appearance.

d. Apply plaster and finishes to match adjacent interior walls and partition areas for openings sealed with brick and/or masonry block.

3.05 INSTALLATION

A. Install equipment and materials in accordance with the Contract Documents, approved Shop Drawings, and manufacturer's installation instructions. When manufacturer's installation instructions conflict with the Contract Documents, obtain interpretation or clarification from Engineer before proceeding.

B. Preparation of surfaces shall be performed prior to installation of equipment and material.

1. New floor finishes: Repair and patch with concrete, asphalt latex type emulsion and underlayment as required for existing surfaces or new flooring surfaces.

2. Ceramic tile flooring or bases installed over concrete floors: Grind away cove, if present, for installation of new Work.

C. Concrete surfaces shall achieve compression strength in accordance with the Contract Documents prior to installation of equipment and materials.

1. Anchor bolts and templates shall be provided by Contractor and as specified in the individual Specification Sections.

2. Concrete foundations shall be treated with sealer to prevent oil from seeping into concrete as specified in the individual Specification Sections.

D. Maintain the work area in a broom-clean condition while installing materials and equipment.

E. Contractor shall be responsible for equipment for hoisting, lifting, moving, rigging, etc. for installation of equipment and materials.

1. Contractor shall be responsible for design of temporary installation system used for the installation Work, unless otherwise indicated in the Contract Documents.

2. Contractor shall be responsible for damage to existing structure, equipment, and material caused prior, during, and following installation of the Work with the Contractor furnished temporary installation system at no cost to Owner. Repairs shall be in accordance with the Contract Documents, shall return to condition prior to installation Work, and as directed by the Engineer.

3. Owner's hoists, monorails, bridge cranes, rigging, etc. shall not be used by the Contractor unless written authorization is provided by Owner.

F. Alteration or repair of new equipment and materials shall not be permitted without written authorization from Engineer.

G. Field welding or burning of new equipment and materials shall not be permitted unless indicated in the Contract Documents or without written authorization from Engineer.

H. Contractors shall install temporary shoring and bracing where necessary during installation of the Work where required:

1. System shall be provided in accordance with the Contract Documents and code requirements.

2. Temporary system shall consist of adjustable sound timbers or rolled shapes easily removable following installation of the Work.

3. Contractor shall be responsible for damage to existing structures and new Work during installation, utilization, and removal of the temporary system at new additional cost to the Owner.

I. Manufacturer's Installation Services: Provide competent, qualified manufacturer's representatives of equipment and material for services specified in the individual Specification Sections, including, but not limited to:

1. Supervising installation

2. Checking the completed installation

3. Adjusting and testing of equipment and materials

4. Instructing Owner's operations and maintenance in accordance with Section 01 79 00 – Instruction of Owner's Personnel.

END OF SECTION

SECTION 01 73 23

ANCHORAGE AND BRACING OF NONSTRUCTURAL COMPONENTS

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. Furnish all equipment, labor, materials, and services required to design and provide anchorage and bracing for all nonstructural components in accordance with the Contract Documents and Building Code requirements.

B. This Section covers requirements for only the anchorage and bracing of nonstructural components. Design requirements for nonstructural components (other than their anchorage and bracing) are covered in the Section for that component.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01 45 33 – Special Inspections

B. Section 05 05 23 – Metal Fastening

C. Section 05 10 00 – Metal Materials

D. Further requirements for anchorage and bracing are included in other Sections of the Specifications. See Section for the specific nonstructural component in question.

1.03 DEFINITIONS

A. Nonstructural components: All architectural, mechanical, electrical, or plumbing elements or systems and their supports or attachments provided under this contract which are permanently attached to new or existing structures.

1. Architectural nonstructural components include, but are not limited to, interior nonstructural walls and partitions, exterior wall panels and glazing elements, glass curtain walls, skylights, cabinets, suspended ceilings, fascia, and cladding.

2. Mechanical nonstructural components include, but are not limited to, HVAC units, fans, water and wastewater treatment process equipment, instrumentation cabinets, piping and ductwork.

3. Electrical nonstructural components include, but are not limited to, conduit systems, cable tray systems, boxes, transformers, panelboards, switchboards, switchgear, busway, individual motor controllers, motor control centers, variable frequency drives, automatic transfer switches, and lighting systems.

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4. Plumbing nonstructural components include, but are not limited to, sprinkler systems and associated piping, and sump pumps.

B. Attachment: Elements including anchor bolts, welded connections, and mechanical fasteners which secure nonstructural components or supports to the structure.

C. Essential Components: Nonstructural components considered necessary to public safety, including:

1. Life safety systems, including but not limited to, sprinklers for fire protection, emergency lighting, egress corridors and stairways, and smoke purge systems.

2. Components which contain, convey or support toxic, highly toxic, or explosive substances where the quantity of the material exceeds a threshold quantity established by the Building Code.

3. Components which are within or attached to an Occupancy or Risk Category IV structure as defined in ASCE 7 Chapter 1 and are needed for continued operation of the facility or failure could impair the continued operation of the facility.

4. Components which contain, convey, or support hazardous substances and are attached to a structure or portion thereof classified by the Building Code as a hazardous occupancy.

D. Nonbuilding Structures: All self-supporting structures which are supported by an independent foundation or by other structures which include, but are not limited to, storage tanks, silos, exhaust stacks, storage racks, and towers.

E. Delegated Design: Design of a structure or structural element(s) which has been deferred by the contract documents to be performed during the project construction stage, by a registered design professional retained by the Contractor and with the design submitted as a shop drawing to the Engineer.

1.04 REQUIREMENTS

A. Anchorage and bracing of nonstructural components shall be designed and installed to resist the controlling load combination of gravity loads, operational forces (including static and dynamic), wind forces, and any other applicable forces required in accordance with the governing Building Code.

1.05 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of the Specifications, all work herein shall conform to or exceed the applicable requirements of the following documents. The Building Code shall be the version of the Florida Building Code in effect at the time of Bid. All other referenced specifications, codes, and standards refer to the version as referenced by the Building Code. If no version is referenced by the Building Code, then the most current issue available at the time of Bid shall be used.

1. Florida Building Code

2. ASCE/SEI 7 Minimum Design Loads for Buildings and Other Structures

3. NFPA 13 Standard for Installation of Sprinkler Systems

4. FEMA 412 Installing Seismic Restraints for Mechanical Equipment

5. FEMA 413 Installing Seismic Restraints for Electrical Equipment

6. FEMA 414 Installing Seismic Restraints for Duct and Pipe

7. SMACNA Sheet Metal and Air Conditioning Contractors' National Association, Seismic Restraint Manual: Guidelines for Mechanical Systems

8. ACI 318 Building Code Requirements for Structural Concrete and Commentary

9. ACI 355.2 Qualifications of Post-Installed Mechanical Anchors in Concrete

10. ACI 355.4 Qualifications of Post-Installed Adhesive Anchors in Concrete

1.06 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittal Procedures.

1. Anchorage and bracing submittals for all architectural, mechanical, electrical, and plumbing nonstructural components, elements and systems that do not have a design for anchorage and bracing provided within the Contract Documents. Submittals shall include the following:

   a. Component manufacturer's cut sheets and fabrication details for equipment bases and foundations, including dimensions, structural member sizes, support point locations and equipment operational loads. Equipment anchorage details shall clearly indicate anchor size, pattern, embedment, and edge distance requirements to satisfy operational, wind, and other forces required by the governing Building Code. Details shall also indicate grout, bearing pads, isolators, etc. required for complete installation.

   b. Design calculations, signed and sealed by a Professional Engineer registered in the State of Florida. Design shall include all loads and load combinations required by the Building Code. Separate calculation submittals for vertical and lateral load support systems shall not be allowed.

   c. Detailed Shop Drawings, signed and sealed by a Professional Engineer registered in the State of Florida, showing specific details of the support design including material, installation, attachments, connection hardware, etc., and the layout and location of all hangers and supports (resisting both

gravity and lateral loads), including bracing orientation and direction of force(s) to be resisted.

1.07 DESIGN REQUIREMENTS

A. Mechanical fasteners used to secure nonstructural components shall meet the requirements of Section 05 05 23 – Metal Fastening.

B. No reaction loads (either vertical or lateral) from nonstructural component anchorage and bracing shall be allowed on any element where design has been delegated unless the additional loads on the element have been coordinated with the delegated designer and the submittal is accompanied by a sealed letter from the delegated designer indicating the element has been designed to support the reaction loads.

C. Reaction loads from nonstructural component anchorage and bracing shall be transferred directly to the primary structural members (girders, beams, etc.), with no components supported from secondary members (purlins, bracing, etc.) unless otherwise approved.

D. No holes shall be drilled into any structural steel for attachment of component supports without prior approval of the Engineer.

E. Attachments of nonstructural component anchorage and bracing that cause overstressing of any structural element shall not be permitted.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Anchorage and bracing of nonstructural components shall be constructed of appropriate materials and connecting hardware to provide a continuous load path between the component and supporting structure of sufficient strength and stiffness to resist the calculated design forces and displacements.

B. Component anchorage, bracing and connection materials shall be compatible with and in general match the component and component gravity support materials. Contact between dissimilar metals shall be prevented.

PART 3 – EXECUTION

3.01 INSTALLATION OF ANCHORAGE AND BRACING

A. No anchorage and bracing of nonstructural components shall be installed prior to review and acceptance by the Engineer and permitting agency.

B. Equipment shall be installed per the manufacturer's recommendations. Fasteners shall meet manufacturer's requirements.

C. Following installation, all anchorage and bracing shall be inspected. See Section 01 45 33 – Special Inspections for requirements.

END OF SECTION

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SECTION 01 74 00

CLEANING AND WASTE MANAGEMENT

PART 1 – GENERAL

1.01 SUMMARY

A. Administrative and procedural requirements for progress and closeout cleaning at the Site.

1. Contractor shall execute cleaning during the Project, at completion of the Work, and as required by the General Conditions and this Section.

2. Maintain in a clean manner the Site, the Work, and areas adjacent to or affected by the Work.

B. Administrative and procedural requirements for disposing of non-hazardous excavation and construction waste.

1. Contractor shall comply with the requirements and procedures for construction waste management and disposal, including developing and implementing a plan for construction waste management and disposal.

2. Extent of required construction waste management and disposal includes within the Project limits, as shown or indicated.

1.02 REFERENCES

A. Definitions:

1. “Waste Management Coordinator” is the person responsible for implementing, monitoring, and reporting the status of the Waste Management Plan. Although available for other assignments, the Waste Management Coordinator shall be present at the Site full time for the duration of the Work.

2. “Construction waste” is building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.

3. “Demolition waste” is building and site improvement materials resulting from demolition or selective demolition operations.

4. “Disposal” is removal to an off-Site location of demolition and construction waste and subsequent sale, recycling, reuse, or disposal in a landfill or incinerator

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conforming to Laws and Regulations and acceptable to authorities having jurisdiction.

B. Reference Standards: NFPA 241, Safeguarding Construction, Alteration, and Demolition Operations

1.03 DELIVERY, STORAGE AND HANDLING

A. Replace loaded containers with empty containers as demand requires.

B. Deposit recyclable materials in containers free from debris.

C. Transport and deposit waste in containers to minimize dust. Close container covers immediately after materials are deposited.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.01 PROGRESS CLEANING

A. General: Clean the Site, work areas, and other areas occupied by Contractor at least weekly. Dispose of materials in accordance with the General Conditions and the following:

1. Comply with NFPA 241 for removing combustible waste materials and debris.

2. Do not hold non-combustible materials at the Site more than three days if the temperature is expected to rise above 80 degrees F. When temperature is less than 80 degrees F, dispose of non-combustible materials within seven days of their generation.

3. Provide suitable containers for storage of waste materials and debris.

4. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately.

B. Work Areas:

1. Clean areas where the Work is in progress to level of cleanliness necessary for proper execution of the Work.

2. Remove liquid spills promptly and immediately report spills to Owner, Engineer, and authorities having jurisdiction.

3. Where dust would impair proper execution of the Work, broom-clean or vacuum entire work area, as appropriate.

4. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

C. Installed Work: Keep installed Work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of material or equipment installed, using only cleaning agents and methods specifically recommended by material or equipment manufacturer. If manufacturer does not recommend specific cleaning agents or methods, use cleaning agents and methods that are not hazardous to health and property and that will not damage exposed surfaces.

D. Exposed Surfaces: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration until Substantial Completion.

E. Cutting and Patching:

1. Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar materials.

2. Thoroughly clean piping, conduit, and similar features before applying paint or other finishing materials. Restore damaged pipe covering to its original condition.

F. During handling and installation of materials and equipment, clean and protect construction in progress and adjoining materials and equipment already in place. Apply protective covering where required for protection from damage or deterioration, until Substantial Completion.

G. Clean completed construction as frequently as necessary throughout the construction period.

3.02 EXCAVATION WORK NEAR PUBLIC OR PRIVATE PROPERTY

A. Contractor shall provide cleaning and either temporary or permanent restoration where Work is located in or near streets, right of ways, easements, or private property.

B. Contractor shall backfill, compact, grade, and restore excavation or disturbed area to functional condition to permit pedestrian or vehicular traffic and original use of the area as the Work progresses.

C. Temporary storage of excavation spoils, including earth, stones, boulders, and debris, shall be removed from the Site or area of disturbance.

3.03 CLOSEOUT CLEANING

A. Complete the following prior to requesting inspection for Substantial Completion:

1. Clean and remove from the Site rubbish, waste material, debris, and other foreign substances.

2. Sweep paved areas broom-clean. Remove petrochemical spills, stains, and other foreign deposits.

3. Hose-clean sidewalks and loading areas.

4. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.

5. Repair pavement, roads, sod, and other areas affected by construction operations and restore to specified condition; if condition is not specified, restore to pre-construction condition.

6. Clean exposed exterior and interior hard-surfaced finishes to dirt-free condition, free of spatter, grease, stains, fingerprints, films, and similar foreign substances.

7. Leave the Site clean, and in neat, orderly condition, satisfactory to Owner and Engineer.

3.04 WASTE DISPOSAL

A. General: Except for items or materials to be recycled, or otherwise reused, remove waste materials from the Site and properly dispose of waste in facility such as permitted landfill or incinerator or other method acceptable to authorities having jurisdiction.

1. Except as otherwise specified, remove from the Site all waste and debris from the Work as it accumulates. Upon completion of the Work, remove materials, equipment, waste, and debris and leave the Site clean, neat, and orderly. Comply with the Contract Documents regarding cleaning and removal of trash, debris, and waste.

2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

3. Properly dispose of waste materials, surplus materials, debris, and rubbish off the Site.

4. Do not discharge volatile or hazardous substances, such as mineral spirits, oil, or paint thinner, into storm sewers or sanitary sewers.

5. Do not discharge wastes into surface waters or drainage routes.

B. Burying: Do not bury rubbish and waste materials at the Site.

C. Burning: Do not burn waste materials at the Site.

D. Disposal: Transport waste materials to proper location at site other than Owner's property for disposal in accordance with Laws and Regulations. Contractor shall be solely responsible for complying with Laws and Regulations regarding storing, transporting, and disposing of waste.

END OF SECTION

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SECTION 01 75 00
CHECKOUT AND STARTUP PROCEDURES

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Checkout of products and equipment.

2. Startup procedures of products and equipment

B. Contractor shall initially start up and place equipment installed under the Contract into successful operation, in accordance with the equipment manufacturer's written instructions and as instructed by Supplier at the Site.

C. Provide all material, labor, tools, and equipment required to complete equipment checkout and start-up.

D. Provide chemicals, lubricants, and other required operating fluids.

E. Contractor shall furnish all personnel, power, water, chemicals, fuel, oil, grease, and all other necessary equipment, facilities, and services required for conducting the tests except as otherwise accepted by the Engineer.

F. General activities include:

1. Cleaning, as required under other provisions of the Contract Documents.

2. Removing temporary protective coatings.

3. Checking and correcting (if necessary) leveling plates, grout, bearing plates, anchorage devices, fasteners, and alignment of piping, conduits, and ducts that may place stress on the connected equipment.

4. All adjustments required.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Definitions:

1. Displacement, as used herein, shall mean total peak-to-peak movement of vibrating equipment, in mils; velocity or speed of the vibration cycle, measured in distance per time, velocity and acceleration of the vibration cycle. Displacement,

velocity and acceleration shall be measured by instruments/equipment equal to IRD Mechanalysis, Bentley, Nevada.

B. Coordination:

1. Coordinate checkout and start-up with other contractors performing Work at the Site.

2. Do not start up system or subsystem for continuous operation until all components of that system or subsystem, including instrumentation and controls, have been tested to the extent practicable and proven to be operable as intended by the Contract Documents.

3. Responsibility for proper operation is by Contractor.

4. Supplier shall be present during checkout, start-up, and initial operation, except as otherwise specified.

5. Do not start up system, unit process, or equipment without submitting acceptable preliminary operations and maintenance manuals by Contractor, in accordance with Section 01 78 23 – Operations and Maintenance Data.

C. Contractor's Requirements Prior to Owner's Responsibility:

1. Owner will assume responsibility for the equipment upon Substantial Completion.

2. Prior to turning over to Owner responsibility for operating and maintaining system or equipment shall be in accordance with this Section and the following requirements:

a. Submit acceptable final operations and maintenance manuals in accordance with Section 01 78 23 – Operations and Maintenance Data.

b. Provide training of operations and maintenance personnel in accordance with Section 01 79 00 – Instruction of Owner's Personnel.

c. Complete system field quality control testing in accordance with the Contract Documents including, but not limited to, the following:

1) Start-up certification shall be performed and completed by the equipment Supplier for the equipment and material prior to be placed into intended use by Owner as specified in the Contract Documents.

2) Equipment and material shall be operated for a minimum 14-day operational period to verify performance. In addition to specific requirements specified in the individual specification sections, process

data that is recorded in the PLC shall be submitted to the Engineer in tabular format showing hourly process performance data. A log of all alarms shall also be submitted, along with notes describing corrective measures applied in response to alarm condition.

3) If equipment and material does not perform satisfactorily during the 30-day operational period, then the warranty period start shall be delayed until satisfactorily performance is verified.

a) Contractor shall repair or replace equipment and material that does not perform satisfactorily at no cost to Owner.

b) Contractor shall furnish all equipment and material, labor, and incidentals necessary to provide equipment and material to the performance level required by the Contract Documents.

d. Obtain from Engineer final certificate of Substantial Completion for either entire Work or the portion being turned over to Owner.

1.03 SUBMITTALS

A. Startup Schedule: Detailed summary of schedule, duration, manpower requirement, and Contractor's means and methods for startup.

B. Vibration testing results

C. Closeout Submittals: Manufacturer's certification of installation in accordance with this Section.

D. Startup testing and operational demonstration performance data.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.01 PRELIMINARY REQUIREMENTS

A. Prior to the start-up of the facilities, Contractor shall have prepared and tested all equipment, subsystems and systems in accordance with the requirements of the individual Specification Section to check its ability for sustained operation, including inspections and adjustments by Manufacturer's representative.

B. Contractor shall develop and submit schedule in accordance with this Section.

C. After the facilities are sufficiently complete to permit start-up, Contractor shall furnish competent personnel to start-up the facilities. Contractor will be responsible for startup of all facilities constructed under this Contract. During the initial start-up period the Contractor shall check and provide for mechanical operation in accordance with the Contract Documents.

3.02 FIELD QUALITY CONTROL

A. Manufacturers' Field Services:

1. When specified, furnish services of factory trained representatives of material and equipment manufacturers as specified, including supervising installation, adjusting, checkout, start-up, and testing of materials and equipment.

2. Certification:

a. When services by manufacturer are required at the Site, within 14 days after first test operation of equipment, submit to Engineer a letter from manufacturer, on manufacturer's letterhead, stating that materials and equipment are installed in accordance with manufacturer's requirements and installation instructions, and in accordance with the Contract Documents.

b. Include in the final operations and maintenance manual for the associated equipment a copy of the letter or completed form, as applicable.

3. Manufacturer shall bring any discrepancies to the immediate attention of the Contractor for correction. Contractor shall promptly correct any discrepancies noted by the Manufacturer. Manufacturer shall coordinate correction of discrepancies with the Contractor. Discrepancies and their correction shall be noted in inspection records and in all required reports. Any corrections that result in changes to the work as shown on the Contract Documents shall be approved by the Engineer prior to their execution.

3.03 VIBRATION TESTING

A. Stationary rotating equipment, products and materials shall have vibration testing performed at the Site with a rated horsepower exceeding 40 horsepower unless noted otherwise in the individual equipment specifications.

B. Vibration testing shall be performed by an experienced factory-trained and authorized third-party analysis expert shall be provided for and paid for by the Contractor. Each unit or pump system shall be tested separately without duplicate equipment running. All field testing shall be done in the presence of the Engineer. The Engineer shall be furnished with seven (7) certified copies of vibration test data for each test performed.

C. General testing requirements:

1. Variable speed drives – Tests shall be conducted at the full range of speeds between maximum and minimum.

2. Two-speed drives – Tests shall be conducted at both speeds.

3. Constant-speed drives – Tests shall be conducted under various loading conditions as determined by the Engineer.

4. Frequency of vibration, in frequency (i.e. Hz, cycles per second) and cycles per minute (cpm), shall be determined when vibration exceeds specified levels or as otherwise necessary. Vibration shall be measured on the bearing housing and the motor, unless other additional locations are deemed necessary by the Engineer and/or specified, the vibration analyst and/or published industry standards.

5. Vibration shall be checked in the radial and axial directions. Vibration shall be limited to the latest version of the following published standards: ISO, Hydraulic Institute (HI).

    a. Unless otherwise specified elsewhere, axial vibration shall not exceed 0.1 in/sec; and radial vibration shall not exceed 0.2 in/sec. For pumps radial vibration shall not exceed that permitted by the Hydraulic Institute Standards except that, at vibration frequencies in excess of 8,000 cpm, the velocity shall not exceed 0.2 in/sec.

6. Noise or vibration in any rotating equipment which the Engineer judges to be excessive or damaging, shall be cause for rejection.

D. Test results:

1. Contractor shall correct deficiencies within thirty days when vibration field test results exceed source quality control tests results, Manufacturer's recommendations, or the limits specified in the Contract Documents.

2. After corrections have been completed, the vibration testing shall be re-run at the Contractor's expense and the results re-submitted to the Engineer for review.

3.04 SYSTEM START-UP

A. Equipment and materials shall be provided in conformance with the manufacturer's installation instructions and in accordance with the Contract Documents.

B. Provide start-up services as specified in the individual Specification Sections.

C. Contractor shall furnish consumables required for startup including, but not limited to, electricity, water, chemicals and lubrication. Contractor shall provide a plan for disposal of water used for testing unless otherwise specified in the Contract Documents.

D. General system requirements:

1. Start-up of the plant by Contractor shall include all mechanical systems, including but not limited to, pumps, compressors, and like equipment, and the ventilating, air conditioning (or heating), plumbing, and electrical systems.

2. Cleaning as required under provisions of the Contract Documents.

3. Remove temporary protective coatings.

4. Flushing and replacing greases and lubricants as required by Manufacturer

5. Lubrication.

6. Verify the following:

    a. Shaft and coupling alignments and reset where needed.

    b. Set motor, pump and other equipment rotation, safety interlocks, and belt tensions.

    c. Leveling plates, grout, bearing plates, anchor bolts, fasteners, and alignment of piping, conduits and ducts that may apply stress on equipment.

7. Valves:

    a. Tighten packing glands to ensure no leakage but allow valve stems to operate without galling.

    b. Replace packing in valves to retain maximum adjustment after system is determined to be complete.

    c. Replace packing on valves that continue to leak.

    d. Remove and repair bonnets that leak.

    e. After cleaning, coat packing gland threads and valve stems with surface preparation of “Molycote” or “Fel-Pro”.

8. Verify that control valve seats are free of foreign matter and are properly positioned for intended service.

9. Tighten flanges and other pipe joints after system has been placed in operation.

10. Replace gaskets that show signs of leakage after tightening.

11. Inspect all joints for leakage:

a. Promptly remake each joint that appears to be faulty; do not wait for rust other corrosion to form.

b. Clean threads on both parts and apply compound and remake joints.

12. After system has been placed in operation, clean valve seats and headers in fluid system to ensure freedom from foreign matter.

13. Remove rust, scale, and foreign matter from equipment and renew defaced surfaces.

14. Repair damaged insulation.

END OF SECTION

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SECTION 01 77 19
CLOSEOUT REQUIREMENTS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Substantial Completion.

2. Final inspection.

3. Request for final payment.

1.02 REFERENCES

A. Definitions:

1. Substantial completion procedures for requesting and documenting are in the General Conditions, as modified by Supplemental Conditions.

2. Final inspection procedures for requesting and documenting are in the General Conditions, as modified by Supplemental Conditions.

1.03 ADMINSTRATIVE REQUIREMENTS

A. Request for Final Payment:

1. Procedure: Submit request for final payment in accordance with the Agreement and General Conditions, as may be modified by the Supplementary Conditions.

B. Request for final payment shall include:

1. Documents required for progress payments in Section 01 29 76 – Progress Payment Procedures.

2. Documents required in the General Conditions, as may be modified by the Supplementary Conditions.

3. Releases or Waivers of Lien Rights:

a. Provide a final release or waiver by Contractor and each Subcontractor and Supplier that provided Contractor with labor, material, or equipment totaling $10,000 or more.

b. Provide list of Subcontractors and Suppliers for which release or waiver of Lien is required.

c. Each release or waiver of Lien shall be signed by an authorized representative of the entity submitting release or waiver to Contractor, and shall include Subcontractor's or Supplier's corporate seal, when applicable.

d. Release or waiver of Lien may be conditional upon receipt of final payment.

e. Manufacturer's Affidavit of Release of Liens – furnish a separate, completed form from the manufacturer.

4. Consent of Surety Company to Final Payment.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01 78 23
OPERATION AND MAINTENANCE DATA

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes: Requirements for operation and maintenance data, manuals, and documentation.

1. Submit operation and maintenance data, in accordance with this Section and in accordance with requirements elsewhere in the Contract Documents, as instructional and reference manuals by operations and maintenance personnel at the Site.

2. Required operation and maintenance data groupings are listed in this Section. At minimum, submit operation and maintenance data for:

a. All equipment and systems

b. Valves, gates, actuators, and related accessories

c. Instrumentation and control devices

d. Electrical gear

3. For each operation and maintenance manual, submit the following:

a. Preliminary Submittal: Printed and bound copy of entire operation and maintenance manual or electronic copy, except for test data and service reports by Supplier.

b. Final Submittal: Printed and bound copy of complete operations and maintenance manual and electronic copy, including test data and service reports by Supplier.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Quantity Required and Timing of Submittals:

1. Preliminary Submittal:

a. Printed Copies: One copy, exclusive of copies required by Contractor.

b. Electronic Copies: One copy.

c. Submit to Engineer, whichever occurs first:

1) 60 days prior to starting training of operations and maintenance personnel.

2) 30 days prior to field quality control testing at the Site.

3) 30 days prior to unloading equipment and material at the Site.

d. Furnish preliminary operation and maintenance data submittal in acceptable form and content, as determined by Engineer, before associated materials and equipment will be eligible for payment.

2. Preliminary Submittal shall be reviewed by Engineer. One printed or electronic copy shall be returned to Contractor with required revisions noted.

3. Final Submittal: Provide 14 days prior to checkout and startup procedures specified in Section 01 75 00 – Checkout and Startup Procedures, unless Submittal is specified as required prior to an interim Milestone.

a. Printed Copies: Two copies.

b. Electronic Copies: One copy.

B. Format of Printed Copies:

1. Binding and Cover:

a. Bind each operation and maintenance manual in durable, permanent, stiff-cover binder(s), comprising one or more volumes per copy as required. Binders shall be minimum one-inch wide and maximum of three-inch wide. Binders for each copy of each volume shall be identical.

b. Provide the following information on cover of each volume:

1) Title: “OPERATING AND MAINTENANCE INSTRUCTIONS”.

2) Name or type of material or equipment covered in the manual.

3) Volume number, if more than one volume is required, listed as “Volume __ of __”, with appropriate volume-designating numbers filled in.

4) Name of Project and, if applicable, Contract name and number.

5) Name of building or structure, as applicable.

c. Provide the following information on spine of each volume:

1) Title: “OPERATING AND MAINTENANCE INSTRUCTIONS”.

2) Name or type of material or equipment covered in the manual.

3) Volume number, if more than one volume is required, listed as “Volume __ of __”, with appropriate volume-designating numbers filled in.

4) Project name and building or structure name.

2. Drawings:

a. Bind into the manual drawings, diagrams, and illustrations up to and including 11 inches by 17 inches in size, with reinforcing.

b. Documents larger than 11 inches by 17 inches shall be folded and inserted into clear plastic pockets bound into the manual. Mark pockets with printed text indicating content and drawing numbers. Include no more than three drawing sheets per pocket.

3. Copy Quality and Document Clarity:

a. Contents shall be original-quality copies. Documents in the manual shall be either original manufacturer-printed documents or first-generation photocopies indistinguishable from originals. If original is in color, copies shall be in color.

b. Clearly mark in ink to indicate all components of materials and equipment on catalog pages for ease of identification. In standard or pre-printed documents, indicate options furnished or cross out inapplicable content.

4. Organization:

a. Provide table of contents in each volume for each chapter or section.

b. Use dividers and indexed tabs between major categories of information, such as operating instructions, preventive maintenance instructions, and other major subdivisions of data in each manual.

C. Format of Electronic Copies:

1. Each electronic copy shall include all information included in the corresponding printed copy.

2. Submit electronic copy via transferable method and format acceptable to Engineer.

3. File Format:

a. Acceptable formats include Adobe PDF, Microsoft Word, Autodesk DWF, and AutoCAD.

b. Files shall be electronically searchable.

c. Submit separate file for each separate document in the printed copy.

d. Within each file, provide bookmarks for the following:

1) Each chapter and subsection listed in the corresponding printed copy document's table of contents

2) Each figure

3) Each table

4) Each appendix

4. Submit drawings and figures in one of the following formats: ".bmp", ".tif", ".jpg", ".gif", "dwf", or "dwg".

D. General Content Requirements:

1. Prepare each operations and maintenance manual specifically for the Project. Include in each manual all pertinent instructions, as-built drawings as applicable, bills of materials, technical bulletins, installation and handling requirements, maintenance and repair instructions, and other information required for complete, accurate, and comprehensive data for safe and proper operation, maintenance, and repair of materials and equipment furnished for the Project. Include in manuals specific information required in the Specification Section for the material or equipment, data required by Laws and Regulations, and data required by authorities having jurisdiction.

2. Submit complete, detailed written operating instructions for each material or equipment item including: function; operating characteristics; limiting conditions; operating instructions for start-up, normal and emergency conditions; regulation and control; operational troubleshooting; and shutdown. Also include, as applicable, written descriptions of alarms generated by equipment and proper responses to such alarm conditions.

3. Submit written explanations of all safety considerations relating to operation and maintenance procedures.

4. Submit complete, detailed, written preventive maintenance instructions including all information and instructions to keep materials, equipment, and systems properly lubricated, adjusted, and maintained so that materials, equipment, and

systems function economically throughout their expected service life. Instructions shall include:

a. Written explanations with illustrations for each preventive maintenance task such as inspection, adjustment, lubrication, calibration, and cleaning. Include pre-startup checklists for each equipment item and maintenance requirements for long-term shutdowns.

b. Recommended schedule for each preventive maintenance task.

c. Lubrication charts indicating recommended types of lubricants, frequency of application or change, and where each lubricant is to be used or applied.

d. Table of alternative lubricants.

e. Troubleshooting instructions.

f. List of required maintenance tools and equipment.

5. Submit complete bills of material or parts lists for materials and equipment furnished. Lists or bills of material may be furnished on a per-drawing or per-equipment assembly basis. Bills of material shall indicate:

a. Manufacturer’s name, address, telephone number, fax number, and Internet website address.

b. Manufacturer’s local service representative’s or local parts supplier’s name, address, telephone number, fax number, Internet website address, and e-mail addresses, when applicable.

c. Manufacturer’s shop order and serial number(s) for materials, equipment or assembly furnished.

d. For each part or piece include the following information:

1) Parts cross-reference number. Cross-reference number shall be used to identify the part on assembly drawings, Shop Drawings, or other type of graphic illustration where the part is clearly shown or indicated.

2) Part name or description.

3) Manufacturer’s part number.

4) Quantity of each part used in each assembly.

5) Current unit price of the part at the time the operations and maintenance manual is submitted. Price list shall be dated.

6. Submit complete instructions for ordering replaceable parts, including reference numbers (such as shop order number or serial number).

7. Submit manufacturer's recommended inventory levels for spare parts, extra stock materials, and consumable supplies for the initial two years of operation. Consumable supplies are items consumed or worn by operation of materials or equipment, and items used in maintaining the operation of material or equipment, including items such as lubricants, seals, reagents, and testing chemicals used for calibrating or operating the equipment. Include estimated delivery times, shelf life limitations, and special storage requirements.

8. Submit manufacturer's installation and operation bulletins, diagrams, schematics, and equipment cutaways. Where materials pertain to multiple models or types, mark the literature to indicate specific material or equipment supplied. Marking may be in the form of checking, arrows, or underlining to indicate pertinent information, or by crossing out or other means of obliterating information that does not apply to the materials and equipment furnished.

9. Submit original-quality copies of each approved and accepted Shop Drawing, product data, and other submittal, updated to indicate as-installed condition. Reduced drawings are acceptable only if reduction is to not less than one-half original size and all lines, dimensions, lettering, and text are completely legible on the reduction.

10. Submit complete electrical schematics and wiring diagrams, including complete point-to-point wiring and wiring numbers or colors between all terminal points.

11. Submit copy of warranty bond and service contract as applicable.

12. When copyrighted material is used in operations and maintenance manuals, obtain copyright holder's written permission to use such material in the operation and maintenance manual.

1.03 SUBMITTALS

A. Action/Informational Submittals: Submit preliminary schedule (listing) of operations and maintenance data for Engineer's review. Preliminary operations and maintenance data shall be grouped as major equipment and material systems and divided into sub-systems as required for clarity, subject to Engineer's approval.

B. Closeout Submittals:

1. Operation and maintenance data: Submit the operations and maintenance data indicated in the Contract Documents, grouped into submittals as approved by Engineer.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.01 SCHEDULE (NOT USED)

END OF SECTION

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SECTION 01 78 39
PROJECT RECORD DOCUMENTS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Requirements for recording changes to record documents.

2. Requirements for electronic files furnished by Engineer.

B. Contractor shall maintain and submit to Engineer with record documents in accordance with the Specifications, General Conditions, and Supplementary Conditions.

1.02 ADMINSTRATIVE REQUIREMENTS

A. Maintenance of Record Documents:

1. The following record documents shall be maintained in the Contractor's field office:

a. Drawings, Specifications, and Addenda.

b. Shop Drawings, Samples, and other Contractor submittals, including records of test results, approved or accepted as applicable, by Engineer.

c. Change Orders, Work Change Directives, Field Orders, photographic documentation, survey data, and all other documents pertinent to the Work.

2. Update record documents on a monthly basis, minimum.

3. Provide files and racks for proper storage and easy access to record documents.

4. Make record documents available for inspection upon request of Engineer or Owner.

5. Do not use record documents for purpose other than serving as Project record. Do not remove record documents from Contractor's field office without Engineer's approval.

B. Submittal of Record Documents:

1. Submit to Engineer the following record documents: Drawings.

2. Prior to readiness for final payment, submit to Engineer one copy of final record documents. Submit complete record documents; do not make partial submittals.

3. Submit record documents with transmittal letter on contractor letterhead complying with letter of transmittal requirements in Section 01 33 00 – Submittal Procedures.

4. Record documents submittal shall include certification, with original signature of official authorized to execute legal agreements on behalf of Contractor.

C. Electronic Files Furnished by Engineer:

1. CADD files will be furnished by Engineer upon the following conditions:

a. Contractor shall submit to Engineer a letter on Contractor letterhead requesting CADD files and providing specific definition(s) or description(s) of how files will be used, and specific description of benefits to Owner (including credit proposal, if applicable) if the request is granted.

b. Contractor shall execute Engineer's standard agreement for release of electronic files and shall abide by all provisions of the agreement for release of electronic files.

c. Layering system incorporated in CADD files shall be maintained as transmitted by Engineer. CADD files transmitted by Engineer containing cross-referenced files shall not be bound by Contractor. Drawing cross-references and paths shall be maintained. If Contractor alters layers or cross-reference files, Contractor shall restore all layers and cross-references prior to submitting record documents to Engineer.

d. Contractor shall submit record drawings to Engineer in same CADD format that files were furnished to Contractor.

1.03 SUBMITTALS

A. Closeout Submittals: Provide record documentation as specified in this Section.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.01 GENERAL REQUIREMENTS:

A. At the start of the Project, label each record document to be submitted as, "PROJECT RECORD" using legible, printed letters. Letters on record copy of the Drawings shall be two inches high.

B. Keep record documents current. Make entries on record documents within two working days of receipt of information required to record the change.

C. Do not permanently conceal the Work until required information has been recorded.

D. Accuracy of record documents shall be such that future searches for items shown on the record documents may rely reasonably on information obtained from Engineer-accepted record documents.

E. Marking of Entries:

1. Use erasable, colored pencils (not ink or indelible pencil) for marking changes, revisions, additions, and deletions to record documents.

2. Clearly describe the change by graphic line and make notations as required. Use straight-edge to mark straight lines. Writing shall be legible and sufficiently dark to allow scanning of record documents into legible electronic files.

3. Date all entries on record documents.

4. Call attention to changes by drawing a “cloud” around the change(s) indicated.

5. Mark initial revisions in red. In the event of overlapping changes, use different colors for subsequent changes.

3.02 RECORDING CHANGES TO DRAWINGS:

A. Record changes on copy of the Drawings. Submittal of Contractor-originated or -produced drawings as a substitute for recording changes on the Drawings is unacceptable.

B. Record changes on plans, sections, schematics, and details as required for clarity, making reference dimensions and elevations (to Project datum) for complete record documentation.

C. Record actual construction including:

1. Depths of various elements of foundation relative to Project datum.

2. Field changes of dimensions, arrangements, and details.

3. Changes made in accordance with Change Orders, Work Change Directives, and Field Orders.

4. Changes in details on the Drawings. Submit additional details prepared by Contractor when required to document changes.

3.03 RECORDING CHANGES FOR SCHEMATIC LAYOUTS:

A. In some cases, on the Drawings, arrangements of conduits, circuits, piping, ducts, and similar items are shown schematically and are not intended to portray physical layout. For such cases, the final physical arrangement shall be determined by Contractor subject to acceptance by Engineer.

B. Record on record documents all revisions to schematics on Drawings, including: piping schematics, ducting schematics, process and instrumentation diagrams, control and circuitry diagrams, electrical one-line diagrams, motor control center layouts, and other schematics when included in the Contract. Record actual locations of equipment, lighting fixtures, in-place grounding system, and other pertinent data.

C. When dimensioned plans and dimensioned sections on the Drawings show the Work schematically, indicate on the record documents, by dimensions accurate to within one inch in the field, centerline location of items of Work such as conduit, piping, ducts, and similar items

1. Clearly identify the Work item by accurate notations such as “cast iron drain”, “rigid electrical conduit”, “copper waterline”, and similar descriptions.

2. Show by symbol or note the vertical location of Work item; for example, “embedded in slab”, “under slab”, “in ceiling plenum”, “exposed”, and similar designations. For piping not embedded, also provide elevation dimension relative to Project datum.

3. Descriptions shall be sufficiently detailed to be related to Specifications.

D. Engineer may furnish written waiver of requirements relative to schematic layouts shown on plans and sections when, in Engineer’s judgment, dimensioned layouts of Work shown schematically will serve no useful purpose. Do not rely on waiver(s) being issued.

3.04 REQUIREMENTS FOR SUPPLEMENTAL DRAWINGS:

A. In some cases, drawings produced during construction by Engineer or Contractor supplement the Drawings and shall be included with record documents submitted by Contractor. Supplemental record drawings shall include drawings provided with Change Orders, Work Change Directives, and Field Orders and that cannot be incorporated into the Drawings due to space limitations.

B. Supplemental drawings provided with record drawings shall be integrated with the Drawings and include necessary cross-references between drawings. Supplemental record drawings shall be on sheets the same size as the Drawings.

C. When supplemental drawings developed by Contractor using computer-aided drafting/design (CADD) software are to be included in record drawings, submit electronic files for such drawings in AutoCAD (latest version) as part of record drawing submittal.

3.05 RECORDING CHANGES TO DRAWING MODELS

A. Record changes on Engineer supplied electronic models to generate record drawings.

B. Record changes on plans, sections, schematics, and details as required for clarity, making reference dimensions and elevations (to Project datum) for complete record documentation.

C. Record actual construction including:

1. Field changes of dimensions, arrangements, and details.

2. Changes made in accordance with Change Orders, Work Change Directives, and Field Orders.

3. Changes in details on the Drawings. Submit additional details prepared by Contractor when required to document changes.

D. When required, electronic models shall be updated with as-built asset information in accordance with the Contract Documents. Asset information shall be entered and coordinated with electronic model files. Asset information includes equipment, instrumentation, and appurtenance tagging, pipe and valve identification information, and Owner identified equipment and material.

END OF SECTION

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SECTION 01 78 43
SPARE PARTS AND EXTRA MATERIAL

PART 1 – GENERAL

1.01 SUMMARY

A. Contractor shall furnish spare parts data and extra materials for materials and equipment in accordance with the Contract Documents.

B. Spare Parts and Extra Materials:

1. Provide spare parts, extra stock materials, maintenance supplies, and special tools required for maintenance (“spare parts and extra materials”) for one year of operation (unless otherwise specified in the individual Specification Section).

a. Provide Supplier recommended lubricating oil and grease in accordance with this Section and the Contract Documents.

2. Provide list of Supplier recommended spare parts and extra material.

a. Include list of four standard lubricants, minimum, that shall be interchangeable for each type of lubricant required in the Contract Documents.

b. Include unit prices in current United States funds

c. Source(s) of supply for each.

C. Packaging and Labeling:

1. Furnish spare parts and extra materials in manufacturer’s unopened cartons, boxes, crates, or other original, protective covering suitable for preventing corrosion and deterioration for maximum length of storage normally anticipated by manufacturer.

2. Packaging of spare parts and extra materials shall be clearly marked and identified with name of manufacturer, applicable equipment, part number, part description, and part location in the equipment.

3. Protect and package spare parts and extra materials for maximum shelf life normally anticipated by manufacturer.

D. Finishes: Spare parts and extra material shall have painting, protective coating, and finishes identical to original installed equipment and material. Where painting, protective

coating, or finishes are not specified, suitable provisions shall be furnished to protect from corrosion.

E. Special Tools: Contractor shall provide special tools necessary to operate, disassemble, service, repair, and adjust equipment and material in accordance with the manufacturer's operation and maintenance manual. Special tool requirements shall be the same as spare parts and extra material specified in this Section.

F. Storage Prior to Delivery to Owner: Prior to furnishing spare parts and extra materials to Owner, store spare parts and extra materials in accordance with the Contract Documents and manufacturers' recommendations.

G. Delivery Time and Eligibility for Payment:

1. Deliver to Owner spare parts and extra materials prior to date of Substantial Completion for equipment or system associated with the spare parts and extra materials. Do not deliver spare parts and extra materials before commencing start-up for associated equipment or system.

2. Spare parts and extra materials are not eligible for payment until delivered to Owner and Contractor's receipt of Owner's countersignature on letter of transmittal.

H. Procedure for Delivery to Owner:

1. Deliver spare parts and extra materials to Owner's permanent storage rooms at the Site or area(s) at the Site designated by Owner.

2. When spare parts and extra materials are delivered, Engineer and Owner will mutually inventory the spare parts and extra materials delivered to verify compliance with the Contract Documents regarding quantity and part numbers.

3. Additional procedures for delivering spare parts and extra materials to Owner, if required, will be developed by Engineer and complied with by Contractor.

I. Transfer Documentation:

1. Furnish on Contractor letterhead a letter of transmittal for spare parts and extra materials furnished under each Specification Section. Letter of transmittal shall accompany spare parts and extra materials. Do not furnish letter of transmittal separate from associated spare parts and extra materials.

2. Furnish three original, identical, signed letters of transmittal for each Specification Section. Upon delivery of specified quantities and types of spare parts and extra materials to Owner, designated person from Owner will countersign each original letter of transmittal indicating Owner's receipt of spare parts and extra materials.

a. Owner will retain one fully signed original.

b. Contractor shall submit one fully signed original to Engineer.

c. Contractor shall retain one fully signed original for Contractor's file.

3. Letter of transmittal shall include the following:

a. Information required for letters of transmittal in Section 01 33 00 – Submittal Procedures.

b. Transmittal shall list spare parts and extra materials furnished under each Specification Section. List each individual part or product and quantity furnished.

c. Provide space for countersignature by Owner as follows: space for signature, space for printed name, and date.

J. Contractor shall be fully responsible for loss or damage to spare parts and extra materials until spare parts and extra materials are received by Owner.

1.02 SUBMITTALS

A. Action/Informational Submittals: Individual Specification Sections that require spare parts, extra material, or tools, Contractor shall submit inventory checklist for each individual Specification Section that includes the following information:

1. Specification Section number and title.

2. Name of spare parts, extra material, or tools.

3. Manufacturer, part number and description.

4. Quantity specified and furnished.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

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SECTION 01 79 00

INSTRUCTION OF OWNER'S PERSONNEL

PART 1 – GENERAL

1.01 SUMMARY

A. Contractor shall furnish services of operation and maintenance training specialists to instruct Owner's personnel in recommended operation and maintenance procedures for materials and equipment furnished, in accordance with the Contract Documents.

B. Contractor shall provide a combination of classroom and field training at the Site, unless otherwise required elsewhere in the Contract Documents.

C. Owner reserves the right to record training sessions on video for Owner's later use in instructing Owner's personnel.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Definitions:

1. Training -Manufacturer's verbal, visual, and written presentation of materials to Owner's staff to ensure that any Owner personnel undergoing training understand the Manufacturer's recommended procedures to properly operate and maintain the equipment and systems for the expected service life.

B. Qualifications:

1. Contractor's instructors shall be factory-trained by manufacturer of material or equipment.

2. Contractor's instructors shall be proficient and experienced in conducting training of type required.

3. Qualifications of instructors are subject to acceptance by Engineer. If Engineer does not accept qualifications of proposed instructor, furnish services of replacement instructor with acceptable qualifications.

C. Scheduling:

1. General:

a. Contractor shall coordinate training services with start-up and initial operation of materials and equipment on days and times, and in manner, acceptable to Owner, in accordance with the Contract Documents.

b. Training may be required outside of normal business hours to accommodate schedules of operations and maintenance personnel. Furnish training services at the required days and times at no additional cost to Owner.

c. Prerequisites to Training: Training of Owner's personnel shall commence after acceptable preliminary operation and maintenance data has been submitted and work required in Section 01 75 00 – Checkout and Startup Procedures is complete.

2. Training Schedule Submittal:

a. Training Schedule Required: Contractor shall prepare and submit proposed training schedule for review and acceptance by Engineer and Owner. Proposed training schedule shall show all training required in the Contract Documents, and shall demonstrate compliance with specified training requirements relative to number of hours of training, number of training sessions, and scheduling.

b. Timing of Training Schedule Submittal: Submit initial training schedule at least thirty days before scheduled start of first training session. Submit final training schedule, incorporating revisions in accordance with Engineer's comments, no later than seven days prior to starting the first training session.

c. Owner reserved the right to modify personnel availability for training in accordance with process or emergency needs at the Site.

1.03 TRAINING REQUIREMENTS

A. General Lesson Plan Requirements:

1. Contractor's lesson plan shall describe specific instruction topics, system components for which training will be furnished, and training procedures. Handouts, if any, to be used in training shall be included with the lesson plan. Describe in lesson plan "hands-on" demonstrations planned for training sessions.

2. Submit acceptable lesson plan 14 days prior to starting associated training.

3. Lesson plan shall include estimated duration of each training segment.

B. Specific Lesson Plans Requirements:

1. Equipment overview shall cover the following:

a. Equipment's operating (process) function, performance objectives, and fundamental operating principles.

b. Equipment's mechanical, electrical, and electronic components and features. Group related components into subsystems and describe function of subsystem and subsystem's interaction with other subsystems.

c. Support equipment and appurtenances.

d. Safety and potential hazards.

e. Safety and control interlocks.

2. Operations personnel training shall cover the following:

a. Equipment overview: As described in this Section.

b. Operation:

1) Principles, operating, start-up, and shutdown procedures.

2) Abnormal or emergency start-up, operating, and shutdown procedures.

3) Alarm conditions and responses.

4) Monitoring and recordkeeping.

5) Housekeeping.

c. Troubleshooting: Required corrective maintenance or an operating parameter adjustment.

3. Maintenance personnel training:

a. Equipment overview: As described in this Section.

b. Equipment preventive maintenance:

1) Inspection procedures:

a) Operation.

b) Trouble symptoms and anticipate breakdowns.

c) Predictive maintenance.

2) Preventative maintenance intervals.

3) Lubricant and replacement parts.

4) Cleaning practices and intervals.

5) Special tools required.

6) Removal, installation, and disassembly and assembly procedures.

7) “Hands-on” demonstrations of preventive maintenance procedures.

8) Measuring instruments and procedures

9) Torqueing, mounting, calibrating, and aligning procedures and settings requirements.

10) Check and test equipment following corrective maintenance.

4. Equipment Troubleshooting:

a. Systematic troubleshooting procedures.

b. Checklists.

c. Testing and diagnostic procedures.

d. Corrective maintenance procedures with “hands on” demonstrations.

C. Training Aids:

1. Contractor’s instructor shall incorporate training aids as appropriate to assist in the instruction. Provide handouts of text, tables, graphs, and illustrations as required. Other appropriate training aids include:

a. Audio-visual aids

b. Equipment cutaways and samples

c. Tools, including special tools

2. Podium presentation aids: Presentation shall cover equipment, products and materials provided. Provide electronic version of presentation material to Engineer.

a. Electronic version of presentation aids shall be Microsoft PowerPoint or equivalent format.

b. Presentation shall include the following sections:

1) Complete system overview including, but not limited to, related and associated equipment specific to the system.

2) Specific equipment requirements and how equipment functions within the overall system.

3) Site specific system and equipment requirements.

c. Hardcopy handouts of the electronic presentation aids shall be provided prior to each training section for review during podium presentation.

3. Handouts:

a. Contractor's instructor shall distribute and use descriptive handouts during training.

b. Handouts should be coordinated with the instruction

c. Provide at least ten copies of handouts for each training session

4. Audio-visual Equipment: Training provider shall provide audio-visual equipment required for training sessions.

1.04 SUBMITTALS

A. Action/Informational Submittals:

1. Training Schedule: Detailed schedule of training sessions, demonstrating compliance with number of training sessions, hours required in the Contract Documents, and complying with the Contract Times. Submit training schedule submittals in accordance with timeframes specified in this Section.

2. Lesson Plan: Acceptable lesson plan for training on each material or equipment item, in accordance with the Contract Documents. Lesson plan shall comply with requirements of this Section. Include with lesson plan copy of handouts that will be used during training sessions. Provide lesson plan submittals in accordance with timeframes specified in this Section.

3. Podium presentation material, electronic version.

4. Qualifications: Credentials of Contractor's proposed operations and maintenance instructor(s). Credentials shall demonstrate compliance with requirements of this Section and shall include brief resume and specific details of instructor's operating, maintenance, and training experience relative to the specific material and equipment for which instructor will provide training.

B. Closeout Submittals:

1. Trainee sign-in sheet for each training session. Submit to Owner's training coordinator.

C. Quality Assurance Submittals:

1. Qualifications: Credentials of Contractor's proposed operations and maintenance instructor(s). Credentials shall demonstrate compliance with requirements of this Section and shall include brief resume' and specific details of instructor's operating, maintenance, and training experience relative to the specific material and equipment for which instructor will provide training.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.01 "HANDS-ON" DEMONSTRATIONS

A. Contractor's instructor shall provide "hands-on" demonstration of operations and maintenance of equipment and materials for each training session.

B. Contractor shall furnish tools and appurtenances required for demonstrations.

3.02 SCHEDULE

A. Contractor shall furnish the hours of training and number of sessions indicated, at a minimum. Travel time and expenses are the responsibility of the manufacturer and are excluded from required training time indicated in the Contract Documents.

B. Owner's operations at the Site occur 24 hours per day, divided into three shifts. Training shall be scheduled during day shift, normal working hours unless otherwise approved by Engineer.

C. Training shall be provided for a minimum of two identical sessions, unless otherwise specified, with each session scheduled for different weeks.

D. Training schedule shall be coordinated and approved with the Owner and Engineer.

E. Provide training for the following equipment:

Spec. Section	Specification Title	Staff	Class-room Hours	Hands-On Hours	Total Session Hours	Number of Sessions	TOTAL HOURS
40 61 26	Process Control System Training	Maintenance and Operations	2	2	4	4	16
		Electrical and Instrumentation	2	2	4	2	8
46 33 42	Mechanical Diaphragm Metering Pumps	Maintenance and Operations	2	2	4	4	16
		Electrical and Instrumentation	2	2	4	2	8
46 33 43	Solenoid Diaphragm Metering Pumps	Maintenance and Operations	2	2	4	4	16
		Electrical and Instrumentation	2	2	4	2	8

END OF SECTION

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DIVISION 02 – EXISTING CONDITIONS

SECTION 02 32 00
SUBSURFACE EXPLORATION

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall examine the site and review the available geotechnical report or undertake its own subsurface investigation prior to submitting its bid as described herein.

B. The Contractor shall supply subsurface utility engineering (SUE) services to designate, verify and document the location of the existing underground facilities as soon as feasible after receipt of a notice-to-proceed as described herein.

1.02 STANDARDS

A. ASCE 75-22: Standard Guideline for Recording and Exchanging Utility Infrastructure Data

B. ASCE 38-22: Standard Guideline for the Collection and Depiction of Existing Utilities

1.03 SUBMITTALS

A. Comply with the requirements in Section 01 33 00 - Submittal Procedures.

B. Submit all Exploratory Excavation Reports.

C. Submit AutoCAD File of Existing Utility Locations. Additionally, submit PDF that is signed and sealed by the professional land surveyor.

D. Request a CADD seed AutoCAD file from Engineer. Comply with the requirements in Section 01 78 39 - Project Record Documents.

E. Notify the Engineer of any conflicts between the existing and proposed improvements.

1.04 GEOTECHNICAL

A. The Contractor shall assume responsibility for knowledge of soil characteristics in the areas where excavation is required, based on past experience, the knowledge of others, soil tests, or other means available. No claim for extra compensation or for extension of time will be allowed on account of subsurface conditions inconsistent with Contractor's assumptions, except as provided elsewhere herein.

B. A Geotechnical Report is provided, as Appendix A, for information purposes only with the Contract Documents.

C. The City and the Engineer will not assume responsibility for variations of sub-soil quality or conditions at locations other than places shown and at the time the geotechnical investigation was made. The Contractor shall examine the site and review the available geotechnical report or undertake its own subsurface investigation prior to submitting its bid, taking into consideration all conditions that may affect its work.

1.05 EXISTING UTILITIES

A. The plans depict the approximate location of the existing utilities. The location of those facilities (horizontal and vertical) was obtained from survey information, utility atlas, and record drawings provided by utility owners, and a limited amount of utility soft dig information.

B. Existing utilities shown are located according to the information available to the engineer at the time of the topographic survey. Guarantee is not made all existing underground utilities are shown or the location of those shown are accurate. Finding the actual location of any existing utilities is the Contractor's responsibility and shall be done before he commences and works in the vicinity. Furthermore, the Contractor shall be fully responsible for any and all damages due to the Contractor's failure to exactly locate and preserve any and all underground utilities.

1.06 SUBSURFACE UTILITY INVESTIGATION

A. Exploratory Excavation Reports: The Contractor is required to verify all utility crossing elevations via vacuum or direct excavation. The report(s) shall be provided to the Engineer indicating all stations, offsets and elevations. The report(s) shall be provided prior to the commencement of pipe installation. The Engineer will confirm elevations and provide any required revisions to the Contractor.

B. Perform all necessary exploratory excavations and subsurface utility engineering (SUE) services to verify the location, elevation and alignment of existing underground utilities that may interfere with the proposed improvements.

C. Perform all necessary exploratory excavations and SUE services to verify the location, elevation and alignment of existing underground utilities that are indicated for relocation and/or at proposed tie-in locations.

D. Provide American Society of Civil Engineers (ASCE) quality levels "A" and **"**B" subsurface utility engineering (SUE) services to designate, verify and document the location of the existing underground facilities, including yard piping, electrical conduits, and drainage facilities in the areas that may be impacted by construction.

E. Location information collected by the Contractor shall be used by the Contractor to supplement information on existing record drawings available from the City.

F. Standard of Care: Comply with applicable requirements in the following:

1. ASCE 75-22

2. ASCE 38-22

G. AutoCAD File of Existing Utility Locations:

1. The Contractor shall retain a professional land surveyor. The surveyor shall document the vertical and horizontal locations of the utilities that may interfere with the proposed improvements. Horizontal locations shall be in state plane coordinates. Incorporate utility locate information into an AutoCAD drawing that provides the horizontal coordinates and elevations of all located utilities. Submit the AutoCAD file along with a PDF that is signed and sealed by the professional land surveyor.

2. Vertical and horizontal datums shall be as specified in Section 01 78 39 titled "Project Record Documents". If there is a conflict between the datums on the Drawings and that specified in Section 01 78 39 request a clarification from the Engineer.

1.07 CONTRACTOR'S RESPONSIBILITIES

A. Contractor shall notify the Sunshine State One Call of Florida (SSOCF) service at 811, 48 hours prior to digging, as required by Florida Statutes Chapter 556 throughout the duration of the construction project.

B. Locate the cables, ducts, conduit, pipeline, etc. in advance of the proposed construction.

C. Notification of Conflicts: Notify Engineer in writing of any substantial changes and/or conflicts requiring a deviation in the plans. Late discovery of existing underground utilities does not constitute "required" deviations should early discovery prevent them.

D. Support existing utilities not proposed for replacement, including VCP sewer pipe as may be present. Repair any damage done to existing utilities at no additional expense to the City.

E. Remove or modify those utilities scheduled to be removed or modified on the plans.

F. All pipe and materials not abandoned in place shall be removed and disposed of off-site in a legal manner.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

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SECTION 02 41 00

SITE DEMOLITION

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish all labor, materials, and equipment in accordance with the requirements of applicable sections of Divisions 1 and 2.

B. In addition, the Contractor shall demolish and remove all concrete and asphalt paving, curbs, sidewalk, and miscellaneous yard piping, utilities, and structures as required and shown on the Contract Drawings during the construction work.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01 14 00 – Coordination with Owner's Operations

B. Section 01 42 00 – References

C. Section 01 73 00 – Demolition and Execution of Work

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. References shall be in accordance with reference standards, codes, and specifications as set forth herein and in Section 31 10 00 – Clearing, Grubbing, and Site Preparation.

1.04 SUBMITTALS

A. In accordance with the procedures and requirements set forth in Section 01 33 00 – Submittal Procedures, the Contractor shall submit the following:

1. Copies of all photographs and other records from the joint existing conditions surveys.

PART 2 – EXECUTION

2.01 DEMOLITION

A. Existing concrete and asphalt paving, curbs, sidewalk and miscellaneous yard piping, utilities, and structures within the areas designated for new construction work shall be demolished and all debris removed from the site.

B. Excavation caused by demolition shall be backfilled with fill free from rubbish and debris. Select fill or structural fill shall be used where specifically required on Contract Drawings.

C. Work shall be performed in such manner as not to endanger the safety of the workmen or the public or cause damage to nearby structures.

D. Provide all barriers and precautionary measures in accordance with Owner's requirements and other authorities having jurisdiction.

E. Where parts of existing pavements or structures are to remain in service, demolish the portions to be removed, repair damage, and leave the pavement or structure in proper condition for the intended use. Remove asphalt or concrete pavement, concrete, and masonry to the lines designated by saw-cutting, drilling, chipping, or other suitable methods. Leave the resulting surfaces reasonably true and even, with sharp straight corners that will result in neat joints with new construction and be satisfactory for the purpose intended. Where existing reinforcement extends into new construction, remove the concrete so that the reinforcing is clean and undamaged. Cut off other reinforcing 1/2-inch below the surface and fill with epoxy resin binder flush with the surface.

F. Prior to the execution of the work, the Contractor, Owner and Engineer shall jointly survey the condition of the adjoining and/or nearby pavements and structures. Photographs and records shall be made of any prior settlement or cracking of structures, pavements, and the like, that may become the subject of possible damage claims. Contractor shall provide Owner a copy of all records of the joint survey of conditions before demolition activities may begin.

2.02 DISPOSAL OF MATERIAL

A. All debris resulting from the demolition and removal work shall be disposed of by the Contractor at a properly permitted facility as part of the work of this Contract. All regulations covering material handling and disposal shall be followed. Material designated by the Engineer to be salvaged shall be stored on the construction site as directed. All other material shall be disposed of off-site by the Contractor at the Contractor’s expense.

B. Burning of any debris resulting from the demolition will not be permitted at the site.

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 02 41 13
PAVEMENT REMOVAL AND REPLACEMENT

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall cut, remove, protect, and replace existing pavements of the various types encountered including roadways, driveways, sidewalks, curbs, and combination curb and gutter.

B. Protection of Existing Improvements: The Contractor shall be responsible for the protection of all pavements, sidewalks, and other improvements within the work area. All damage to such improvements as a result of the Contractor's operations, beyond the limits of the Work of pavement replacement as described herein, shall be repaired by the Contractor at his expense.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 32 12 00 – Asphalt Concrete Pavement

B. Section 32 15 00 – Limerock Base

PART 2 – PRODUCTS

2.01 MATERIALS

A. Materials including bituminous prime and tack coat, and asphaltic concrete for the above Work shall be as specified in Section 32 12 00 – Asphalt Concrete Pavement

B. Limerock material shall be as specified in Section 32 15 00 – Limerock Base.

PART 3 – EXECUTION

3.01 PREPARATION

A. Pedestrian or school crossings: Where the work crosses or interferes with school or pedestrian crossings, extreme care shall be taken by the Contractor to ensure the safety of school children or other pedestrians.

3.02 REMOVALS

A. Pavement Removal: Where existing pavement is to be removed, the surfacing shall be mechanical saw cut prior to trench excavation, leaving a uniform and straight edge, with minimum disturbance to the remaining adjacent surfacing. The width of cut for this phase of existing pavement removal shall be minimal.

B. Sidewalk, Drive, and Curb Removal: Concrete sidewalks, curbs, combination curb and gutter, walks, drive ribbons, or driveways shall be removed by initially sawing the structure with a suitable power saw as specified above for pavement. When a formed joint in the concrete exists within three (3) feet of the proposed saw cut and parallels the proposed saw cut, the removal line shall be extended to the formed joint. After sawing, the material shall be removed.

3.03 RESTORATIONS

A. General: Street or roadway pavement cut and removed in connection with trench excavation shall be replaced or restored in equal or better condition than the original and as shown on the Drawings. All restorations shall be a complete overlay of the road surface.

B. Pavement Restoration - Asphalt:

1. Limerock base course shall be compacted for its full thickness as specified in Section 32 15 00 – Limerock Base.

2. Construction methods and equipment shall generally meet the requirements therefore as established in the FDOT Specifications. Any such modifications shall be approved by the Engineer prior to their use.

3. Joints with existing surface and base shall be straight and neat. If it is necessary to obtain a straight net joint, the Contractor shall cut out sufficient existing material and replace it with new material.

4. The upper surface of the completed base course shall be compacted to an elevation to permit the full depth of the surface course to be at the pavement surface. The completed surface shall match the line and grade of the existing surface. When pavement is removed to the edge of the roadway, the replaced base course shall extend not less than six (6) inches beyond the edge of the surfacing constructed without deviating from the grade.

C. Driveway Restoration - Asphalt: Driveway pavement with limerock base cut and removed in connection with trench excavation shall be replaced or restored as specified above for street or roadway pavement, with the exception that the new limerock base course shall equal the existing base course in thickness, except that in no case shall new driveway base course be less than six (6) inches in thickness. Muck or unsuitable material found under existing driveway construction will not be removed and replaced.

D. Concrete, Sidewalk, Walkway, Driveway Ribbon, and Curb Restoration:

1. Concrete sidewalks, walkways, driveways, driveway ribbons, and curbs required to be removed for the installation of facilities under this Contract shall be restored. Class B concrete shall be used in all cases.

2. Replaced portions of these items shall conform to the lines, grades, and cross sections of the removed portions. Concrete sidewalks and walkways shall be of 4-inch thickness; concrete driveways and driveway ribbons shall be of 6-inch thickness. Replaced concrete curb and/or gutter shall joint neatly to the remaining section.

E. Pavement Restoration - Concrete: Rigid pavement shall be replaced in kind with Class B concrete, using high early strength cement.

END OF SECTION

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SECTION 02 60 00

CONTAMINATED SOIL

PART 1 – GENERAL

1.01 WORK INCLUDED

A. The City of Hollywood South Regional Wastewater Treatment Plant (SRWWTP) has been identified as a site containing the presence of petroleum products. The SRWWTP is identified on the Broward County Contaminated Sites mapping tool as Site No. 0766A having identified pollutants of diesel and heating oil.

B. Payment for work in this Section is included as an Allowance in the Bid Form. The Contractor shall be responsible for appropriate measurement of unit quantity (volume or weight) of waste material removed from the site, and for verification of those quantities with receipt records from the disposal site.

C. This Section covers the Work necessary to remove, transport, and properly dispose of the following wastes:

1. Liquid petroleum product.

2. Affected soil.

3. Free petroleum product.

1.02 DEFINITIONS

A. Liquid petroleum product (product) is fluid petroleum product partly or entirely composed of diesel fuel or gasoline.

B. Affected soil is defined in Article 3.02 of this Section.

C. Free petroleum product is defined as a liquid which forms a separate floating phase distinct from the groundwater.

1.03 SUBMITTALS

A. Submittals shall be made in accordance with the requirements of the Contract Documents and the requirements of this Section.

B. The Contractor Shall Provide the Following Submittals:

1. A written description of the proposed method for temporary stockpiling, transportation, and disposal of all wastes.

2. Copy of permits of disposal facilities.

3. Certification of disposal of all wastes.

4. Copy of manifests for all wastes leaving the site.

5. Copy of the laboratory analyses required for transportation and disposal of all wastes in accordance with applicable federal, state, and local requirements.

6. Provide name, address, and phone number of all subcontractors.

PART 2 – MATERIALS (NOT USED)

PART 3 – EXECUTION

3.01 LIQUID PETROLEUM PRODUCT

A. Classification of liquid petroleum product shall be made by the Contractor's laboratory responsible for the testing of the product.

B. The Contractor shall remove all liquid petroleum product if discovered in the trench during dewatering operations.

C. If the petroleum product is discovered, the product will be disposed as described herein.

D. If contamination is discovered and it is determined that it must be removed, the Contractor shall commence remediation activities as determined by the Engineer. During the remediation activities, the Contractor shall move to another location as determined by the City to resume normal construction activities. There shall be no delay or mobilization claim associated with moving to another project area, unless all other Work has been completed.

3.02 AFFECTED SOIL

A. Excavation of affected soil shall be accomplished in accordance with the Contract Documents. The soil may be contaminated with petroleum product which may be partly or entirely diesel fuel, gasoline, or chlorinated solvents.

B. Classification of affected soil for disposal purposes will be determined by the Contractor using an Organic Vapor Monitor (OVM) with photo ionization detector or equivalent provided by the Consultant/Geologist.

C. Soils with vapor readings higher than 10 parts per million (ppm) for diesel as defined in Chapter 62-770 of the Florida Administrative Code, are excessively contaminated.

D. Affected soil must be placed on an impermeable barrier when temporarily stockpiled. All stockpile leachate or runoff must be collected for disposal in accordance with applicable federal, state, and local regulations.

E. Soils designated for removal and disposal shall be prepared for shipment, transported, and disposed of in accordance with the requirements of this Section.

F. Affected soils shall be processed by incineration at a state licensed facility. These soils shall be transported and disposed of in accordance with federal, state, and local regulations. The Contractor shall be responsible for all soil analyses required for transportation and disposal.

G. The Contractor shall be responsible for testing soil which has been incinerated to certify the treated soil meets applicable federal, state, and local regulations for final disposal.

3.03 FREE PETROLEUM PRODUCT

A. Some free petroleum products which may be partly or entirely diesel fuel or gasoline may be encountered during excavation activities. The Contractor shall remove free petroleum product, if necessary, when a separate floating phase greater than 0.10-inch thick is present as required by health and safety considerations. The free petroleum product shall be removed by skimming, pumping to an oil/water separator, or other approved methods.

B. Free petroleum products shall be transported and disposed by the Contractor in accordance with federal, state, and local regulations. The Contractor is responsible for any laboratory analyses required for disposal of the free petroleum products.

3.04 TRANSPORT AND DISPOSAL

A. Transport Regulations: The Contractor shall be responsible for the loading, labeling, placarding, marking, weighing, and transporting of all waste materials in accordance with the Florida Department of Transportation Regulations, and U.S. Department of Transportation Regulations. The Contractor shall use only transporters that are licensed and competent to haul these wastes.

3.05 WASTE CONTAINERS

A. Each transport container of waste shall be visually inspected by the Contractor for leaks, drips, or container damage prior to being loaded. Containers which are found to be leaking or damaged shall not be loaded until the damage is repaired. The Contractor shall prepare the transport container to prevent spillage or contamination. The Contractor shall notify the City two hours before any loaded transport leaves the site.

B. All transport containers leaving the site shall be inspected by the Contractor to ensure that no waste material adheres to the wheels or undercarriage.

C. All vehicles on which waste is adhering shall be cleaned by sweeping tires and undercarriage or by other dry methods prior to leaving the site.

3.06 SHIPPING RECORDS

A. The Contractor shall prepare accurate shipping records for any wastes leaving the site in accordance with applicable federal and state regulations. The Contractor shall be responsible for providing copies of the records to the City and shall immediately notify the City of any problems in completing shipments and disposal of wastes.

B. The Contractor shall:

1. Be responsible for appropriate measurement of unit quantity (weight or volume) of waste material removed from the site.

2. Coordinate vehicle inspection and recording of quantities leaving the site with the City. These quantities shall be compared to recorded quantities received at the treatment or disposal facilities. The Contractor shall resolve any discrepancies occurring immediately, determining the probable cause for the discrepancy.

3. Be solely responsible for any and all actions necessary to remedy situations involving waste spiked in transit.

C. The Contractor shall ensure that a copy of the manifest is returned to the City by the designated treatment or disposal facility within 14 days of receipt of the material to be disposed.

3.07 COORDINATION

A. The Contractor shall at any time provide the City with safe access to the Work whenever it is in preparation or progress for the purposes of conducting inspections or collecting samples. The Contractor may conduct concurrent sampling and analyses, if desired. Results of any such sampling and analysis shall be furnished to the City at no cost.

END OF SECTION

DIVISION 03 – CONCRETE

SECTION 03 11 00
CONCRETE FORMWORK

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. Provide materials, labor, and equipment required for the design and construction of all concrete formwork, bracing, shoring and supports in accordance with the provisions of the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 03 21 00 – Reinforcing Steel

B. Section 03 15 00 – Concrete Accessories

C. Section 03 15 16 – Joints in Concrete

D. Section 03 30 00 – Cast-in-Place Concrete

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.

1. Florida Building Code

2. ACI 318 – Building Code Requirements for Structural Concrete

3. ACI 301 – Specifications for Structural Concrete

4. ACI 347 – Recommended Practice for Concrete Formwork

5. U.S. Product Standard for Concrete Forms, Class I, PS 1

6. ACI 117 – Specification for Tolerances for Concrete Construction and Materials and Commentary

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittal Procedures.

1. Manufacturer's data on proposed form release agent

2. Manufacturer's data on proposed formwork system including form ties

1.05 QUALITY ASSURANCE

A. Concrete formwork shall be in accordance with ACI 301, ACI 318, and ACI 347.

PART 2 – PRODUCTS

2.01 FORMS AND FALSEWORK

A. All forms shall be smooth surface forms unless otherwise specified.

B. Wood materials for concrete forms and falsework shall conform to the following requirements:

1. Lumber for bracing, shoring, or supporting forms shall be Douglas Fir or Southern Pine, construction grade or better, in conformance with U.S. Product Standard PS20. All lumber used for forms, shoring or bracing shall be new material.

2. Plywood for concrete formwork shall be new, waterproof, synthetic resin bonded, exterior type Douglas Fir or Southern Pine high density overlaid (HDO) plywood manufactured especially for concrete formwork and shall conform to the requirements of PS1 for Concrete Forms, Class I, and shall be edge sealed. Thickness shall be as required to support concrete at the rate it is placed, but not less than 5/8-inch thick.

C. Other form materials such as metal, fiberglass, or other acceptable material that will not adversely affect the concrete and will facilitate placement of concrete to the shape, form, line and grade indicated may be submitted to the Engineer for approval, but only materials that will produce a smooth form finish equal or better than the wood materials specified will be considered.

2.02 FORMWORK ACCESSORIES

A. Form ties shall be provided with a plastic cone or other suitable means for forming a conical hole to ensure that the form tie may be broken off back of the face of the concrete. The maximum diameter of removable cones for rod ties, or of other removable form-tie fasteners having a circular cross-section, shall not exceed 7/8-inch, and all such fasteners shall be such as to leave holes of regular shape for reaming.

B. Form ties for water-retaining structures shall have integral waterstops. Removable taper ties may be used when acceptable to the Engineer. A preformed mechanical EPDM rubber plug shall be used to seal the hole left after the removal of the taper tie. Plug shall be X-Plug by the Sika Corporation or approved equal. Friction fit plugs shall not be used.

C. Form release agent shall be a blend of natural and synthetic chemicals that employs a chemical reaction to provide quick, easy and clean release of concrete from forms. It shall not stain the concrete and shall leave the concrete with a paintable surface. Formulation of the form release agent shall be such that it would minimize formation of "bug holes" in cast-in-place concrete.

PART 3 – EXECUTION

3.01 FORM DESIGN

A. Forms and falsework shall be designed for total dead load, plus all construction live load as outlined in ACI 347. Design and engineering of formwork and safety considerations during construction shall be the responsibility of the Contractor.

B. Forms shall be of sufficient strength and rigidity to maintain their position and shape under the loads and operations incident to placing and vibrating the concrete. The maximum deflection of facing materials reflected in concrete surfaces exposed to view shall be 1/240 of the span between structural members.

C. All forms shall be designed for predetermined placing rates per hour, considering expected air temperatures and setting rates.

3.02 CONSTRUCTION

A. The type, size, quality, and strength of all materials from which forms are made shall be subject to the approval of the Engineer. No falsework or forms shall be used which are not clean and suitable. Deformed, broken or defective falsework and forms shall be removed from the work.

B. Forms shall be smooth and free from surface irregularities. Suitable and effective means shall be provided on all forms for holding adjacent edges and ends of panels and sections tightly together and in accurate alignment so as to prevent the formation of ridges, fins, offsets, or similar surface defects in the finished concrete. Joints between the forms shall be sealed to eliminate any irregularities. The arrangement of the facing material shall be orderly and symmetrical, with the number of seams kept to a practical minimum.

C. Forms shall be true to line and grade and shall be sufficiently rigid to prevent displacement and sagging between supports. Curved forms shall be used for curved and circular structures. Straight panels joined at angles will not be acceptable for forming curved structures. Forms shall be properly braced or tied together to maintain their position and shape under a load of freshly placed concrete. Facing material shall be supported with studs or other backing which shall prevent both visible deflection marks in the concrete and deflections beyond the tolerances specified.

D. Forms shall be mortar tight to prevent the loss of water, cement and fines during placing and vibrating of the concrete. Specifically, the bottom of wall forms that rest on concrete

footings or slabs shall be provided with a gasket to prevent loss of fines and paste during placement and vibration of concrete. Such gasket may be a 1 to 1-1/2-inch diameter polyethylene rod held in position to the underside of the wall form.

E. All vertical surfaces of concrete members shall be formed, and side forms shall be provided for all footings, slab edges and grade beams, except where placement of the concrete against the ground is called for on the Drawings. Not less than 1-inch of concrete shall be added to the thickness of the concrete member as shown where concrete is permitted to be placed against trimmed ground in lieu of forms. Such permission will be granted only for members of comparatively limited height and where the character of the ground is such that it can be trimmed to the required lines and will stand securely without caving or sloughing until the concrete has been placed.

F. All forms shall be constructed in such a manner that they can be removed without hammering or prying against the concrete. Wood forms shall be constructed for wall openings to facilitate loosening and to counteract swelling of the forms.

G. Adequate clean-out holes shall be provided at the bottom of each lift of forms. Temporary openings shall be provided at the base of column forms and wall forms and at other points to facilitate cleaning and observation immediately before the concrete is deposited. The size, number and location of such clean-outs shall be as acceptable to the Engineer.

H. Construction joints shall not be permitted at locations other than those shown or specified, except as may be acceptable to the Engineer. When a second lift is placed on hardened concrete, special precautions shall be taken in the way of the number, location and tightening of ties at the top of the old lift and bottom of the new to prevent any unsatisfactory effect whatsoever on the concrete. For flush surfaces at construction joints exposed to view, the contact surface of the form sheathing over the hardened concrete in the previous placement shall be lapped by not more than 1 inch. Forms shall be held against hardened concrete to prevent offset or loss of mortar at construction joints and to maintain a true surface.

I. The formwork shall be cambered to compensate for anticipated deflections in the formwork due to the weight and pressure of the fresh concrete and due to construction loads. Set forms and intermediate screed strips for slabs accurately to produce the designated elevations and contours of the finished surface. Ensure that edge forms and screed strips are sufficiently strong to support vibrating screeds or roller pipe screeds if the nature of the finish specified requires the use of such equipment. When formwork is cambered, set screeds to a like camber to maintain the proper concrete thickness.

J. Positive means of adjustment (wedges or jacks) for shores and struts shall be provided and all settlement shall be taken up during concrete placing operation. Shores and struts shall be securely braced against lateral deflections. Wedges shall be fastened firmly in place after final adjustment of forms prior to concrete placement. Formwork shall be anchored to shores or other supporting surfaces or members to prevent upward or lateral

movement of any part of the formwork system during concrete placement. If adequate foundation for shores cannot be secured, trussed supports shall be provided.

K. Runways shall be provided for moving equipment with struts or legs. Runways shall be supported directly on the formwork or structural member without resting on the reinforcing steel.

3.03 TOLERANCES

A. Unless otherwise indicated in the Contract Documents, formwork shall be constructed so that the concrete surfaces will conform to the tolerance limits listed in ACI 117.

B. Structural framing of reinforced concrete around elevators and stairways shall be accurately plumbed and located within 1/4 in. tolerance from established dimensions.

C. The Contractor shall establish and maintain in an undisturbed condition and until final completion and acceptance of the project, sufficient control points and benchmarks to be used for reference purposes to check tolerances. Plumb and string lines shall be installed before concrete placement and shall be maintained during placement. Such lines shall be used by Contractor's personnel and by the Engineer and shall be in sufficient number and properly installed. During concrete placement, the Contractor shall continually monitor plumb and string line form positions and immediately correct deficiencies.

D. Regardless of the tolerances specified, no portion of the structure shall extend beyond the legal boundary of the structure.

3.04 FORM ACCESSORIES

A. Suitable moldings shall be placed to bevel or round all exposed corners and edges of beams, columns, walls, slabs, and equipment pads. Chamfers shall be 3/4 inch unless otherwise noted.

B. Form ties shall be so constructed that the ends, or end fasteners, can be removed without causing appreciable spalling at the faces of the concrete. After ends, or end fasteners of form ties have been removed, the embedded portion of the ties shall terminate not less than 2 inches from the formed face of the concrete that is exposed to water or enclosed surfaces above the water surface, and not less than 1 inch from the formed face of all other concrete. Holes left by the removal of form tie cones shall be reamed with suitable toothed reamers to leave the surface of the holes clean and rough before being filled with mortar as specified in Section 03 35 00 – Concrete Finishes. No form-tying device or part thereof, other than metal, shall be left embedded in the concrete. Ties shall not be removed in such manner as to leave a hole extending through the interior of the concrete member. The use of snap-ties which cause spalling of the concrete upon form stripping or tie removal will not be permitted. No snap ties shall be broken off until the concrete is at least three days old. If steel panel forms are used, rubber grommets shall be provided where the ties pass through the form in order to prevent loss of cement paste.

3.05 APPLICATION – FORM RELEASE AGENT

A. Forms for concrete surfaces that will not be subsequently waterproofed shall be coated with a form release agent. Form release agent shall be applied on formwork in accordance with manufacturer's recommendations.

3.06 INSERTS AND EMBEDDED ITEMS

A. Sleeves, pipe stubs, inserts, anchors, expansion joint material, waterstops, and other embedded items shall be positioned accurately and supported against displacement prior to concreting. Voids in sleeves, inserts, and anchor slots shall be filled temporarily with readily removable material to prevent the entry of concrete into the voids.

3.07 FORM CLEANING AND REUSE

A. The inner faces of all forms shall be thoroughly cleaned prior to concreting. Forms may be reused only if in good condition and only if acceptable to the Engineer. Light sanding between uses will be required wherever necessary to obtain uniform surface texture. Unused tie rod holes in forms shall be covered with metal caps or shall be filled by other methods acceptable to the Engineer.

3.08 FORM REMOVAL AND SHORING

A. Forms shall not be disturbed until the concrete has attained sufficient strength. Sufficient strength shall be demonstrated by structural analysis considering proposed loads, strength of forming and shoring system, and concrete strength data. Shoring shall not be removed until the supported member has acquired sufficient strength to support its weight and the load upon it. Members subject to additional loads during construction shall be adequately shored to sustain all resulting stresses. Forms shall be removed in such manner as not to impair safety and serviceability of the structure. All concrete to be exposed by form removal shall have sufficient strength not to be damaged thereby.

B. Provided the strength requirements specified above have been met and subject to the Engineer's approval, forms may be removed at the following minimum times. The Contractor shall assume full responsibility for the strength of all such components from which forms are removed prior to the concrete attaining its full design compressive strength. Shoring may be required at the option of the Engineer beyond these periods.

Ambient Temperature (°F.) During Concrete Placement

	Over 95°	**70°-95°**	**60°-70°**	**50°-60°**	**Below 50°**
Edge Forms for Slabs on Grade	1 day	1 day	1 day	1 day	
Walls	5 days	2 days	2 days	3 days	Do not remove until directed by Engineer (7 days minimum)
Columns	7 days	2 days	3 days	4 days	

Ambient Temperature (°F.) During Concrete Placement

	Over 95°	70°-95°	60°-70°	50°-60°	Below 50°
Beam Soffits	10 days	7 days	7 days	7 days	
Elevated Slabs	12 days	7 days	7 days	7 days	

C. When, in the opinion of the Engineer, conditions of the work or weather justify, forms may be required to remain in place for longer periods of time.

D. An accurate record shall be maintained by the Contractor of the dates of concrete placings and the exact location thereof and the dates of removal of forms. These records shall always be available for inspection at the site, and two copies shall be furnished the Engineer upon completion of the concrete work.

3.09 RESHORING

A. When reshoring is permitted or required the operations shall be planned and subjected to approval by the Engineer.

B. Reshores shall be placed after stripping operations are complete but in no case later than the end of the working day on which stripping occurs.

C. Reshoring for the purpose of early form removal shall be performed so that at no time will large areas of new construction be required to support their own weight. While reshoring is under way, no construction or live loads shall be permitted on the new construction. Reshores shall be tightened to carry their required loads but they shall not be overtightened so that the new construction is overstressed. Reshores shall remain in place until the concrete has reached its specified 28-day strength, unless otherwise specified.

D. For floors supporting shores under newly placed concrete, the original supporting shores shall remain in place or reshores shall be placed. The shoring or reshoring system shall have a capacity sufficient to resist the anticipated loads and, in all cases, shall have a capacity equal to at least one-half of the capacity of the shoring system above. Reshores shall be located directly under a reshore position above unless other locations are permitted.

E. In multi-story buildings, reshoring shall extend over a sufficient number of stories to distribute the weight of newly placed concrete, forms, and construction live loads so the design superimposed loads of the floors supporting shores are not exceeded.

END OF SECTION

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SECTION 03 15 00
CONCRETE ACCESSORIES

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. Furnish all materials, labor and equipment required to provide all concrete accessories including waterstops, expansion joint material, joint sealants, expansion joint seals, crack inducing joint inserts, epoxy bonding agent, and neoprene bearing pads.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 03 11 00 – Concrete Formwork

B. Section 03 15 16 – Joints in Concrete

C. Section 03 30 00 – Cast-in-Place Concrete

D. Section 07 90 00 – Joint Fillers, Sealants, and Caulking

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.

1. ASTM C881 – Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete

2. ASTM D412 – Standard Tests for Rubber Properties in Tension

3. ASTM D 624 – Standard Test method for Rubber Property - Tear Resistance

4. ASTM D 638 – Standard Test Method for Tensile Properties of Plastics

5. ASTM D1751 – Standard Specifications for Preformed Expansion Joint fillers for Concrete Paving and Structural Construction (non-extruding and resilient bituminous types)

6. ASTM D 1752 – Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction

7. ASTM D 1171 – Standard Test Method for Ozone Resistance at 500 pphm

8. ASTM D 471 – Standard Test Method for Rubber Properties

9. ASTM D 2240 – Standard Test for Rubber Property – Durometer Hardness

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittal Procedures.

1. Manufacturer's literature on all products specified herein including material certifications.

2. Proposed system for supporting PVC waterstops in position during concrete placement.

3. Samples of products if requested by the Engineer.

PART 2 – PRODUCTS

2.01 POLYVINYL CHLORIDE (PVC) WATERSTOPS

A. PVC waterstops for construction joints shall be flat ribbed type, 6 inches wide with a minimum thickness at any point of 3/8 inches.

B. Waterstops for expansion joints shall be ribbed with a center bulb. They shall be 9 inches wide with a minimum thickness at any point of 3/8 inch unless shown or specified otherwise. The center bulb shall have a minimum outside diameter of 1 inch and a minimum inside diameter of 1/2 inch.

C. The waterstops shall be manufactured from virgin polyvinyl chloride plastic compound and shall not contain any scrap or reclaimed material or pigment whatsoever. The properties of the polyvinyl chloride compound used, as well as the physical properties of the waterstops, shall exceed the requirements of the U.S. Army Corps. of Engineers' Specification CRD-C572. The waterstop material shall have an off-white, milky color.

D. The required minimum physical characteristics for this material are:

1. Tensile strength – 1,750 psi (ASTM D-638).

2. Ultimate elongation – not less than 280% (ASTM D-638).

E. No reclaimed PVC shall be used for the manufacturing of the waterstops. The Contractor shall furnish certification that the proposed waterstops meet the above requirements.

F. PVC waterstops shall be as manufactured by BoMetals, Inc., DuraJoint Concrete Accessories, or Sika Greenstreak.

G. All waterstop intersections, both vertical and horizontal, shall be made from factory fabricated corners and transitions. Only straight butt joint splices shall be made in field.

2.02 RETROFIT WATERSTOPS

A. Retrofit waterstops shall be used where specifically shown on Drawings for sealing joints between existing concrete construction and new construction.

B. Retrofit waterstops shall be PVC waterstops fabricated from material as described in Section 2.01 of this Specification.

C. Retrofit waterstop shall be attached to existing concrete surface as shown on Drawings.

D. Use of split waterstop in lieu of specially fabricated retrofit waterstop will not be acceptable.

E. E. Retrofit Waterstop manufacturer must provide a complete system including all Waterstop, stainless steel anchoring hardware, and epoxy for installation.

F. For construction joints, retrofit waterstop shall be style number 609 by Sika Greenstreak, RF-638 by BoMetals, Inc., or approved equal. For expansion joints, retrofit waterstop shall be style number 667 by Sika Greenstreak, RF-912 by BoMetals, Inc., Type 36RT Retrofit Kit by DuraJoint Concrete Accessories, or approved equal.

2.03 CHEMICAL RESISTANT WATERSTOPS

A. Where specifically noted on Contract Drawings, chemical resistant waterstops shall be used instead of PVC waterstops.

B. Chemical resistant waterstops for construction joints shall be ribbed with a center bulb. They shall be 6 inches wide with a minimum thickness at any point of 3/16 inches.

C. Chemical resistant waterstops for expansion joints shall be ribbed tear web. They shall be 9 inches wide with a tear web designed to accommodate 1 inch of free movement minimum.

D. Chemical resistant retrofit waterstop shall be a minimum of 2½” wide along the ribbed side and a minimum 5” wide along the side attached to the existing concrete surface. Retrofit waterstop shall include a center bulb and shall have a minimum thickness of 3/16”. Retrofit waterstop manufacturer shall provide a complete system including waterstop, stainless steel anchoring hardware and epoxy for installation.

E. Chemical resistant waterstops shall be manufactured from a fully crosslinked thermoplastic vulcanizate rubber.

F. Waterstops shall be TPER by BoMetals, Inc., Earth Shield TPV/TPE-R by JP Specialties, Inc., Westec TPER by Westec Barrier Technologies, or TPE-R by DuraJoint Concrete Accessories.

2.04 WATERPROOF MEMBRANE PATCH

A. Waterproof membrane patch shall be Sikadur Combiflex by Sika Corporation or approved equal. Minimum width of waterstop material shall be twelve (12) inches unless shown otherwise on Contract Drawings.

2.05 HYDROPHILIC WATERSTOPS

A. Hydrophilic waterstops shall be designed to expand under hydrostatic conditions. For hydrostatic head pressure greater than 25 feet, waterstops shall be Adeka Ultra Seal MC-2010MN by Adeka Ultra Seal/OCM, Inc., or Hydrotite CJ-1020-2K by Sika Greenstreak. For hydrostatic head pressure 25 feet or less, Adeka Ultra Seal KBA-1510FP or Hydrotite CJ-1020-2K shall be used. Concrete cover and confinement requirements shall be in accordance with the manufacturer's recommendations.

B. Waterstops shall be fabricated from a chemically modified natural rubber product with a hydrophilic agent. Use of bentonite based waterstop material will not be allowed.

C. Waterstops shall either contain an interior stainless-steel mesh or an interior coextrusion of non-hydrophilic rubber to ensure expansion occurs along the width and thickness of the waterstop thereby restricting the expansion in the longitudinal direction.

2.06 WATERSTOP ADHESIVE

A. Adhesive between waterstops and existing concrete shall be Neoprene Adhesive 77-198 by JGF Adhesives, Sikadur 31 Hi-Mod Gel by Sika Corporation, DP-605 NS Urethane Adhesive by 3M Adhesive Systems.

B. Hydrophilic, non-bentonite water swelling elastic sealant shall be used to bond hydrophilic waterstops to rough surfaces. Hydrophilic elastic sealant shall be P-201 by Adeka Ultra Seal/OCM, Inc., Leakmaster LV-Z by Sika Greenstreak, or approved equal.

2.07 JOINT SEALANTS

A. Joint sealants shall comply with Section 07 90 00 – Joint Fillers, Sealants, and Caulking.

2.08 EXPANSION JOINT MATERIAL

A. Preformed expansion joint material shall be non-extruding, and shall be of the following types:

1. Type I – Sponge rubber, conforming to ASTM D1752, Type I.

2. Type II –Cork, conforming to ASTM D1752, Type II.

3. Type III – Self-expanding cork, conforming to ASTM D1752, Type III.

4. Type IV – Bituminous fiber, conforming to ASTM Designation D1751.

2.09 EXPANSION JOINT SEAL

A. Expansion Joint Seal System shall consist of a preformed neoprene profile, installed using the same dimensions as the joint gap, bonded with a two-component epoxy adhesive, and pressurized during the adhesive cure time.

B. The expansion joint system shall be Hydrozo/Jeene Structural Sealing joint system by Hydrozo/Jeene, Inc.

2.10 CRACK INDUCING JOINT INSERTS

A. Crack inducing joint inserts shall be Zip-Cap by Greenstreak Plastic Products, Zip-Joint by BoMetals, Inc.

2.11 EPOXY BONDING AGENT

A. Epoxy bonding agent shall conform to ASTM C881 and shall be Sikadur 32 Hi-Mod, Sika Corporation, Lyndhurst, N.J.; Euco #452 Epoxy System, Euclid Chemical Company, Cleveland, OH, MasterEmaco ADH Series by Master Builders Solutions.

2.12 EPOXY RESIN BINDER

A. Epoxy resin binder shall conform to the requirements of ASTM C-881, Type III, Grade 3, Class B and C for epoxy resin binder and shall be Sikadur 23, Low-Mod-Gel, manufactured by the Sika Corporation, Lyndhurst, N.J., Flexocrete Gel manufactured by DuraJoint Concrete Accessories or Euco #352 Gel, Euclid Chemical Company, MasterEmaco ADH 327 or 327 RS by Master Builders Solutions.

2.13 BEARING PADS

A. Neoprene bearing pads shall conform to requirements of A4-F3-T.063-B2, Grade 2, Method B, in accordance with the RMA Rubber Handbook. Pads shall be nonlaminated pads having a nominal Shore A durometer hardness of 70 in accordance with ASTM D2240. Adhesive for use with neoprene pads shall be an epoxy-resin compound compatible with the neoprene having a sufficient shear strength to prevent slippage between pads and adjacent bearing surfaces. Adhesive shall be 20+F Contact Cement by Miracle Adhesives Corporation, Neoprene Adhesive 77-198 by IGI Adhesives, Sikadur 31, Hi-Mod Gel by Sika Corporation, or DP-605 NS Urethane Adhesive by 3M Adhesive Systems.

PART 3 – EXECUTION

3.01 GENERAL

A. Unless otherwise shown on the Drawings, waterstops of the type specified herein shall be embedded in the concrete across joints as shown. All waterstops shall be fully continuous for the extent of the joint. Splices necessary to provide such continuity shall be accomplished in conformance to printed instructions of manufacturer of the waterstops. The Contractor shall take suitable precautions and means to support and protect the waterstops during the progress of the Work and shall repair or replace at its own expense any waterstops damaged during the progress of the Work. All waterstops shall be stored so as to permit free circulation of air around the waterstop material.

B. When any waterstop is installed in the concrete on 1 side of a joint, while the other half or portion of the waterstop remains exposed to the atmosphere for more than 14 days, suitable precautions shall be taken to shade and protect the exposed waterstop from direct rays of the sun during the entire exposure and until the exposed portion of the waterstop is embedded in concrete.

3.02 PVC AND CHEMICAL RESISTANT WATERSTOPS

A. PVC and chemical resistant waterstops shall be provided in all construction and expansion joints in water bearing structures and at other such locations as required by the Drawings.

B. Waterstops shall be carefully positioned so that they are embedded to an equal depth in concrete on both sides of the joint. They shall be kept free from oil, grease, mortar or other foreign matter. To ensure proper placement, all waterstops shall be secured in correct position at 12" on center along the length of the waterstop on each side, prior to placing concrete. Such method of support shall be submitted to the Engineer for review and approval. Grommets or small pre-punched holes as close to the edges as possible will be acceptable for securing waterstops.

C. Splices in PVC waterstops and chemical resistant waterstops shall be made with a thermostatically controlled heating element. Only straight butt joint splices will be allowed in the field. Factory fabricated corners and transitions shall be used at all intersections. Splices shall be made in strict accordance with the manufacturer's recommended instructions and procedures. At least three satisfactory sample splices shall be made on the site. The Engineer may require tests on these splices by an approved laboratory. The splices shall exhibit not less than 80 percent of the strength of the unspliced material.

D. All splices in waterstops will be subject to rigid review for misalignment, bubbles, inadequate bond, porosity, cracks, offsets, discoloration, charring, and other defects which would reduce the potential resistance of the material to water pressure at any point. All defective joints shall be replaced with material which will pass said review and all faulty material shall be removed from the site and disposed of by the Contractor at no additional cost to the Owner.

E. Retrofit waterstops shall be installed as shown on Contract Drawings using approved waterstop adhesive and Type 316 stainless steel batten bars and expansion anchors.

F. Waterstop installation and splicing defects which are unacceptable include, but are not limited to the following:

1. Tensile strength less than 80 percent of parent material.

2. Overlapped (not spliced) Waterstop.

3. Misalignment of waterstop geometry at any point greater than 1/16 inch.

4. Visible porosity or charred or burnt material in weld area.

5. Visible signs of splice separation when splice (24 hours or greater) is bent by hand at sharp angle.

3.03 WATERPROOF MEMBRANE PATCH AND HYDROPHILIC WATERSTOPS

A. Patches and waterstops shall be installed only where shown on the Drawings.

B. Patches and waterstops shall be installed in strict accordance with manufacturer's recommendations.

3.04 WATERSTOP ADHESIVE

A. Adhesive shall be applied to both contact surfaces in strict accordance with manufacturer's recommendations.

B. Adhesive shall be used where waterstops are attached to existing concrete surfaces.

3.05 INSTALLATION OF EXPANSION JOINT MATERIAL AND SEALANTS

A. Type I, II, or III shall be used in all expansion joints in structures and concrete pavements unless specifically shown otherwise on the Drawings. Type IV shall be used in sidewalk and curbing and other locations specifically shown on the Drawings.

B. All expansion joints exposed in the finish work, exterior and interior, shall be sealed with the specified joint sealant. Expansion joint material and sealants shall be installed in accordance with manufacturer's recommended procedures and as shown on the Drawings.

C. Expansion joint material that will be exposed after removal of forms shall be cut and trimmed to ensure a neat appearance and shall completely fill the joint except for the space required for the sealant. The material shall be held securely in place and no concrete shall be allowed to enter the joint or the space for the sealant and destroy the proper functions of the joint.

D. A bond breaker shall be used between expansion joint material and sealant. The joint shall be thoroughly clean and free from dirt and debris before the primer and the sealant are applied. Where the finished joint will be visible, masking of the adjoining surfaces shall be carried out to avoid their discoloration. The sealant shall be neatly tooled into place and its finished surfaces shall present a clean and even appearance.

E. Type 1 joint sealant shall be used in all expansion and crack inducing joints in concrete, except where other specific types are required as stated below, and wherever else specified or shown on the Drawings. Sealant shall be furnished in pour grade or gun grade depending on installation requirements. Primers shall be used as required by the manufacturer. The sealant shall be furnished in colors as directed by the Engineer.

F. Type 8 joint sealant shall be used in all concrete pavements and floors subject to heavy traffic and wherever else specified or shown on the Drawings.

G. Type 7 joint sealant shall be used for all joints in chlorine contact tanks and wherever specified or shown on the Drawings.

3.06 EXPANSION JOINT SEAL

A. The expansion joint seal system shall be installed as shown on the Drawings in strict accordance with the manufacturer's recommendations.

3.07 CRACK INDUCING JOINT INSERTS

A. For joints in slabs, inserts shall be floated in fresh concrete during finishing.

B. For joints in walls, inserts shall be secured in place prior to casting wall.

C. Inserts shall be installed true to line at the locations of all joints as shown on the Drawings.

D. Inserts shall extend into concrete sufficient depth as indicated on the Drawings or specified in Section 03 15 16 – Joints in Concrete.

E. Inserts shall not be removed from concrete until concrete has cured sufficiently to prevent chipping or spalling of joint edges due to inadequate concrete strength.

3.08 EPOXY BONDING AGENT

A. The Contractor shall use an epoxy bonding agent for bonding fresh concrete to existing concrete as shown on the Drawings.

B. Bonding surface shall be clean, sound, and free of all dust, laitance, grease, form release agents, curing compounds, and any other foreign particles.

C. Application of bonding agent shall be in strict accordance with manufacturer's recommendations.

D. Fresh concrete shall not be placed against existing concrete if epoxy bonding agent has lost its tackiness.

3.09 EPOXY RESIN BINDER

A. Epoxy resin binder shall be used to seal all existing rebar cut and burned off during demolition operations. Exposed rebar shall be burned back 1/2-inch minimum into existing concrete and the resulting void filled with epoxy resin binder.

3.10 BEARING PADS

A. Care shall be taken in fabricating pads and related metal parts so effects detrimental to the proper performance of the pads, such as uneven bearing and excessive bulging, will not occur.

END OF SECTION

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SECTION 03 15 16

JOINTS IN CONCRETE

PART 1 – GENERAL

1.01 THE REQUIREMENTS

A. Provide all materials, labor and equipment required for the construction of all joints in concrete specified herein and shown on the Drawings.

B. Types of joints in concrete shall be defined as follows:

1. Construction Joints – Intentionally created formed joints between adjacent concrete placements with 100% of reinforcement continuous through joint.

2. Expansion Joints – Formed joints in concrete which separate adjacent sections to allow movement due to dimensional increases and reduction of adjacent sections (temperature and shrinkage). Reinforcement terminates within concrete on each side of joint. Expansion joints may also be considered isolation joints.

3. Contraction Joints – Formed joints in concrete to create interface between concrete placements to allow movement due to dimensional reduction of adjacent sections (shrinkage).

   a. Full Contraction Joints – Formed contraction joints with no bonded reinforcement passing through the joint.

   b. Partial Contraction Joints – Formed contraction joints with no more than 50% of bonded reinforcement passing through the joint.

4. Crack Inducing Joints – Joints formed, tooled, or sawcut in a monolithic placement to create a weakened plane to regulate the location of crack formation due to dimensional reduction of adjacent sections (shrinkage).

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 03 11 00 – Concrete Formwork

B. Section 03 15 00 – Concrete Accessories

C. Section 03 30 00 – Cast-in-Place Concrete

D. Section 07 90 00 – Joint Fillers, Sealants and Caulking

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.

1. ACI 301 – Specifications for Structural Concrete for Buildings

2. ACI 318 – Building Code Requirements for Structural Concrete

3. ACI 350 – Code Requirements for Environmental Engineering Concrete Structures

4. ACI 224.3 – Joints in Concrete Construction

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittal Procedures.

1. Layout drawings showing location and type of all joints to be placed in each structure.

2. Details of proposed joints in each structure.

3. For sawcut crack-inducing joints, submit documentation indicating the following:

   a. Proposed method of sawcutting indicating early entry or conventional sawing.

   b. Description of how work is to be performed including equipment to be utilized, size of crew performing the work and curing methods.

   c. Description of alternate method in case of time constraint issues or failure of equipment.

PART 2 – MATERIALS

2.01 MATERIALS

A. All materials required for joint construction shall comply with Section 03 15 00 - Concrete Accessories and Section 07 90 00 – Joint Fillers, Sealants and Caulking.

PART 3 – EXECUTION

3.01 CONSTRUCTION JOINTS

A. Construction joints shall be as shown on the Drawings. Otherwise, Contractor shall submit description of the joint and proposed location to Engineer for approval. All joints shall be construction joints or expansion joints unless otherwise specified on the Drawings or approved by the Engineer on the joint plan submittal.

B. Unless noted otherwise on the Drawings, construction joints shall be located near the middle of the spans of slabs, beams, and girders unless a beam intersects a girder at this point. In this case, the joints in the girders shall be offset a distance equal to twice the width of the beam. Joints in walls and columns shall be at the underside of floors, slabs, beams, or girders and the top of footings or floor slabs unless noted otherwise on Drawings. Beams, girders, brackets, column capitals, haunches, and drop panels shall be placed at the same time as slabs. Joints shall be perpendicular to the main reinforcement.

C. Maximum distance between horizontal joints in slabs and vertical joints in walls shall be 50’-0”. For exposed walls with fluid or earth on the opposite side, the spacing between vertical and horizontal joints shall be a maximum of 25’-0”.

D. All corners shall be part of a continuous placement, and should a construction joint be required, the joint shall not be located closer than five feet from a corner.

E. All reinforcing steel and welded wire fabric shall be continued across construction joints. Keys and inclined dowels shall be provided as shown on the Drawings or as directed by the Engineer. Longitudinal keys shall be provided in all joints in walls and between walls and slabs or footings, except as specifically noted otherwise on the Drawings. Size of keys shall be as shown on the Drawings.

F. All joints in water bearing structures shall have a waterstop. All joints below grade in walls or slabs which enclose an accessible area shall have a waterstop.

G. Joint plan of walls and slabs shall consider aspect ratio to create placement of sections as close to square as possible. Aspect ratio is defined as the ratio of plan dimensions for slab sections and length to height placement of wall sections. Aspect ratios shall be between 0.65 and 1.5.

3.02 EXPANSION JOINTS

A. Size and location of expansion joints shall be as shown on the Drawings. All joints shall be construction joints or expansion joints unless otherwise specified on the Drawings or approved by the Engineer on the joint plan submittal.

B. All expansion joints in water-bearing structures shall have a center-bulb type waterstop. All expansion joints below grade in walls or slabs which enclose an accessible area shall

have a center-bulb type waterstop. Waterstop shall be as shown on Drawings and specified in Section 03 15 00 – Concrete Accessories.

3.03 CONTRACTION JOINTS

A. Contraction joints shall be located as shown on the Drawings or otherwise approved by the Engineer on the joint plan submittal. Contractor shall submit proposed locations and details of all contraction joints concurrent or prior to submission of reinforcement drawings. Use of contraction joints at locations not specifically detailed on the Drawings requires Engineer approval and will only be considered if meeting the stipulations herein.

B. Full contraction joints may be considered where the structural behavior of the element allows termination of all reinforcement through joint without compromise of structural integrity of element.

C. Partial contraction joints may be considered where the structural behavior of the element requires partial continuation of reinforcement through joint to ensure structural integrity.

D. Where full contraction joints are allowed, maximum distance between horizontal contraction joints in slab and vertical contraction joints in walls shall be 50’-0”. For exposed walls with fluid or earth on the opposite side, spacing between vertical and horizontal contraction joints shall be a maximum of 25’-0”.

E. Bond breaker shall be provided between sections for all contraction joints.

F. Joint plan of walls and slabs shall consider aspect ratio to create placement of sections as close to square as possible. Aspect ratio is defined as the ratio of plan dimensions for slab sections and length to height placement of wall sections. Aspect ratios shall be between 0.65 and 1.5.

3.04 CRACK INDUCING JOINTS

A. Location of crack inducing joints shall be as shown on the Drawings or submitted by Contractor and approved by Engineer.

B. Crack inducing joints shall be formed either by saw cutting, tooling, or use of approved inserts as specified in Section 03 15 00 – Concrete Accessories.

C. If approved by the Engineer, saw cutting of contraction joints in lieu of forming or tooling shall conform to the following requirements:

1. Joints shall be sawed as soon as the concrete can support foot traffic without leaving any impression, normally the same day as concrete is placed and in no case longer than 24 hours after concrete is placed.

2. Curing shall be performed using wet curing methods as indicated in Section 03 39 00 – Concrete Curing. Curing mats, fabrics or sheeting materials shall remain in

place to the extent possible while cutting of joint is being performed. Curing materials shall only be removed as required and shall be immediately reinstalled once cutting of the joint has been completed.

3. Depth of joint shall be as shown on the drawings or noted in these specifications. At locations where the joint cannot be installed to full depth due to curbs or other stopping points hand tools shall be used to complete joints.

4. Saw cut joints shall meet the requirements of ACI 224.3, Section 2.8, Jointing Practice.

D. Unless noted otherwise on Drawings, depth of crack inducing joints shall be 1-1/2 inches in reinforced concrete and 1/3 of concrete thickness in unreinforced concrete.

3.05 JOINT PREPARATION

A. No concrete shall be allowed to enter the joint or the space for the sealant and destroy the proper functions of the joint.

B. The surface of the concrete at all joints shall be thoroughly cleaned and all laitance removed by wire brushing, air or light sand blasting.

C. The joint shall be thoroughly clean and free from dirt and debris before the primer and the sealant are applied. Where the finished joint will be visible, masking of the adjoining surfaces shall be carried out to avoid their discoloration. The sealant shall be neatly tooled into place and its finished surface shall present a clean and even appearance.

D. All joints shall be sealed as shown on the Drawings and specified in Section 03 15 00 – Concrete Accessories.

END OF SECTION

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SECTION 03 21 00
REINFORCING STEEL

PART 1 – GENERAL

1.01 THE REQUIREMENTS

A. Provide all concrete reinforcing including all cutting, bending, fastening and any special work necessary to hold the reinforcing steel in place and protect it from injury and corrosion in accordance with the requirements of this section.

B. Provide deformed reinforcing bars to be grouted into reinforced concrete masonry walls.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 03 11 00 – Concrete Formwork

B. Section 03 15 00 – Concrete Accessories

C. Section 03 30 00 – Cast-in-Place Concrete

D. Section 03 40 00 – Precast Concrete

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.

1. Florida Building Code

2. CRSI - Concrete Reinforcing Institute Manual of Standard Practice

3. ACI SP66 - ACI Detailing Manual

4. ACI 315 - Details and Detailing of Concrete Reinforcing

5. ACI 318 - Building Code Requirements for Structural Concrete

6. WRI - Manual of Standard Practice for Welded Wire Fabric

7. ASTM A 615 - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

8. ASTM A 1064 - Standard Specification for Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete

9. ASTM E 3121 – Standard Test Methods for Field Testing of Anchors in Concrete or Masonry

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittal Procedures.

1. Detailed placing and shop fabricating drawings, prepared in accordance with ACI 315 and ACI Detailing Manual - (SP66), shall be furnished for all concrete reinforcing. These drawings shall be made to such a scale as to clearly show joint locations, openings, and the arrangement, spacing and splicing of the bars.

2. Detailed placing and shop fabricating drawings, prepared in accordance with ACI 315 and ACI Detailing Manual - (SP66), shall be furnished for all deformed bar reinforcing used in masonry. These drawings shall be made to such a scale as to clearly show joint locations, openings, and the arrangement, locations, spacing and splicing of the bars.

3. Mill test certificates - 3 copies of each.

4. Description of the reinforcing steel manufacturer's marking pattern.

5. Requests to relocate any bars that cause interferences or that cause placing tolerances to be violated.

6. Proposed supports for each type of reinforcing.

7. Request to use splices not shown on the Drawings.

8. Request to use mechanical couplers along with manufacturer's literature on mechanical couplers with instructions for installation, and certified test reports on the couplers' capacity.

9. Request for placement of column dowels without the use of templates.

10. Request and procedure to field bend or straighten partially embedded reinforcing.

11. International Code Council–Evaluation Services Report (ICC-ES ESR) for dowel adhesives.

12. Certification that all installers of dowel adhesive systems in horizontal to vertically overhead applications are certified as Adhesive Anchor Installers in accordance with the ACI-CRSI Anchor Installer Certification Program.

13. Adhesive dowel testing plan.

1.05 QUALITY ASSURANCE

A. If requested by the Engineer, the Contractor shall provide samples from each load of reinforcing steel delivered in a quantity adequate for testing. Costs of initial tests will be paid by the Owner. Costs of additional tests due to material failing initial tests shall be paid by the Contractor.

B. Provide a list of names of all installers who are trained by the Manufacturer's Field Representative on this jobsite prior to installation of products. Record must include the installer name, date of training, products included in the training and trainer name and contact information.

C. Provide a copy of the current ACI/CRSI "Adhesive Anchor Installer" certification cards, or equivalent, for all installers who will be installing adhesive anchors in the horizontal to vertically overhead orientation.

D. Inspections of the adhesive dowel system may be made by the Engineer or other representatives of the Owner in accordance with the requirements of the ESR published by the manufacturer. Provide adequate time and access for inspections of products and anchor holes prior to injection, installation, and proof testing.

PART 2 – PRODUCTS

2.01 REINFORCING STEEL

A. Bar reinforcing shall conform to the requirements of ASTM A 615 for Grade 60 deformed billet-steel reinforcing. All reinforcing steel shall be from domestic mills and shall have the manufacturer's mill marking rolled into the bar which shall indicate the producer, size, type, and grade. All reinforcing bars shall be deformed bars. Smooth reinforcing bars shall not be used unless specifically called for on Drawings.

B. Welded wire fabric reinforcing shall conform to the requirements of ASTM A 1064 and the details shown on the Drawings.

C. A certified copy of the mill test on each load of reinforcing steel delivered showing physical and chemical analysis shall be provided, prior to shipment. The Engineer reserves the right to require the Contractor to obtain separate test results from an independent testing laboratory in the event of any questionable steel. When such tests are necessary because of failure to comply with this Specification, such as improper identification, the cost of such tests shall be borne by the Contractor.

D. Field welding of reinforcing steel will not be allowed.

E. Use of coiled reinforcing steel will not be allowed.

2.02 ACCESSORIES

A. Accessories shall include all necessary chairs, slab bolsters, concrete blocks, tie wires, dips, supports, spacers, and other devices to position reinforcing during concrete placement. Wire bar supports shall be plastic protected (CRSI Class 1).

B. Concrete blocks (dobies), used to support and position bottom reinforcing steel, shall have the same or higher compressive strength as specified for the concrete in which it is located.

2.03 MECHANICAL COUPLERS

A. Mechanical couplers shall develop a tensile strength which exceeds 100 percent of the ultimate tensile strength and 125 percent of the yield strength of the reinforcing bars being spliced. The reinforcing steel and coupler used shall be compatible for obtaining the required strength of the connection.

B. Where the type of coupler used is composed of more than one component, all components required for a complete splice shall be supplied.

C. Hot forged sleeve type couplers shall not be used. Acceptable mechanical couplers are Dayton Superior Dowel Bar Splicer System by Dayton Superior, Dayton, Ohio, or approved equal. Mechanical couplers shall only be used where shown on the Drawings or where specifically approved by the Engineer.

D. Where the threaded rebar to be inserted into the coupler reduces the diameter of the bar, the threaded rebar piece shall be provided by the coupler manufacturer.

2.04 DOWEL ADHESIVE SYSTEM

A. Where shown on the Drawings, reinforcing bars anchored into hardened concrete with a dowel adhesive system shall use a two-component adhesive mix which shall be injected with a static mixing nozzle following manufacturer's instructions.

B. All holes shall be drilled in accordance with the manufacturer’s instructions except that core drilled holes shall not be permitted unless specifically allowed by the Engineer. Cored holes, if allowed by the manufacturer and approved by the Engineer, shall be roughened in accordance with manufacturer’s requirements.

C. Thoroughly clean drill holes of all debris, drill dust, and water in accordance with manufacturer’s instructions prior to installation of adhesive and reinforcing bar.

D. Degree of hole dampness shall be in strict accordance with manufacturer recommendations. Installation conditions shall be dry, or water saturated unless otherwise permitted by the engineer. If water saturated installation is approved, appropriate reduction factors in accordance with manufacturer’s design requirements should be

considered. Water filled or submerged holes shall not be permitted unless specifically approved by the Engineer.

E. Injection of adhesive into the hole shall be performed in a manner to minimize the formation of air pockets in accordance with the manufacturer's instructions.

F. Embedment Depth:

1. The embedment depth of the bar shall be as shown on the Drawings. Although all manufacturers listed below are permitted, the embedment depth shown on the Drawings is based on "Pure 110+" by DeWalt" ESR 3298 issued 7/2020. If the Contractor submits one of the other named dowel adhesives from the list below, the Engineer shall evaluate the required embedment and the Contractor shall provide the required embedment depth stipulated by the Engineer specific to the approved dowel adhesive.

2. Where the embedment depth is not shown on the Drawings, the embedment depth shall be determined to provide the minimum allowable bond strength equal to the tensile strength of the rebar according to the manufacturer's ICC-ES ESR.

3. The embedment depth shall be determined using design parameters listed below. In no case shall the embedment depth be less than the minimum, or more than the maximum, embedment depths stated in the manufacturer's ICC-ES ESR.

4. Design of adhesive anchor system shall be based on the following parameters:

a. Actual compressive strength of concrete.

b. Cracked concrete state.

c. Dry or water saturated condition for installation.

d. Base material temperature between 40- and 104-degrees Fahrenheit.

e. Installation with either a hammer drill with carbide bit or hollow-drill bit system drilling methods.

f. Minimum age of concrete 21 days at time of installation.

G. Engineer's approval is required for use of this system in locations other than those shown on the Drawings.

H. The adhesive system shall be IBC compliant for use in both cracked and uncracked concrete in all Seismic Design Categories and shall be "HIT-HY 200 Adhesive Anchoring System" as manufactured by Hilti, Inc. "SET-3G Epoxy Adhesive Anchors" as manufactured by Simpson Strong-Tie Co. or "Pure 110+ Epoxy Adhesive Anchor System" by DeWalt. Fast-set epoxy formulations shall not be acceptable. No or equal products will be considered, unless pre-qualified and approved.

I. All individuals installing dowel adhesive systems in horizontal to vertically overhead applications shall be certified as an Adhesive Anchor Installer in accordance with the ACI-CRSI Anchor Installation Certification Program, or equivalent.

PART 3 – EXECUTION

3.01 FABRICATION

A. Reinforcing steel shall be accurately formed to the dimensions and shapes shown on the Drawings and the fabricating details shall be prepared in accordance with ACI 315 and ACI 318, except as modified by the Drawings.

B. The Contractor shall fabricate reinforcing bars for structures in accordance with the bending diagrams, placing lists and placing Drawings.

C. No fabrication shall commence until approval of Shop Drawings has been obtained. All reinforcing bars shall be shop fabricated unless approved to be bent in the field. Reinforcing bars shall not be straightened or bent in a manner that will injure the material. Heating of bars will not be permitted.

D. Welded wire fabric with longitudinal wire of W9.5 size or smaller shall be either furnished in flat sheets or in rolls with a core diameter of not less than 10 inches. Welded wire fabric with longitudinal wires larger than W9.5 size shall be furnished in flat sheets only.

3.02 DELIVERY, STORAGE AND HANDLING

A. All reinforcing shall be neatly bundled and tagged for placement when delivered to the job site. Bundles shall be properly identified for coordination with mill test reports.

B. Reinforcing steel shall be stored above ground on platforms or other supports and shall always be protected from the weather by suitable covering. Reinforcing steel shall be stored in an orderly manner and plainly marked to facilitate identification.

C. Reinforcing steel shall always be protected from conditions conducive to corrosion until concrete is placed around it.

D. The surfaces of all reinforcing steel and other metalwork to be in contact with concrete shall be thoroughly cleaned of all dirt, grease, loose scale and rust, grout, mortar and other foreign substances immediately before the concrete is placed. Where delay in depositing concrete occurs, reinforcing shall be inspected again and if necessary recleaned.

3.03 PLACING

A. Reinforcing steel shall be accurately positioned as shown on the Drawings and shall be supported and wired together to prevent displacement, using annealed iron wire ties or suitable clips at intersections. All reinforcing steel shall be supported by concrete, plastic

or plastic protected (CRSI Class 1) metal supports, spacers or metal hangers which are strong and rigid enough to prevent any displacement of the reinforcing steel. Where concrete is to be placed on the ground, supporting concrete blocks (or dobies) shall be used in sufficient numbers to support the reinforcing bars without settlement. In no case shall concrete block supports be continuous.

B. The portions of all accessories in contact with the formwork shall be made of plastic or steel coated with a 1/8-inch minimum thickness of plastic which extends at least 1/2 inch from the concrete surface. Plastic shall be gray in color.

C. Tie wires shall be bent away from the forms to provide the specified concrete coverage.

D. Reinforcing bars additional to those shown on the Drawings, which may be found necessary or desirable by the Contractor for the purpose of securing reinforcing in position, shall be provided by the Contractor at no additional cost to the Owner.

E. Reinforcing placing, spacing, and protection tolerances shall be within the limits specified in ACI 318 except where in conflict with the Building Code, unless otherwise specified.

F. Reinforcing bars may be moved within one bar diameter as necessary to avoid interference with other concrete reinforcing, conduits, or embedded items. If bars are moved more than one bar diameter, or enough to exceed placing tolerances, the resulting arrangement of bars shall be as acceptable to the Engineer.

G. Welded wire fabric shall be supported on slab bolsters spaced not less than 30 inches on centers, extending continuously across the entire width of the reinforcing mat and supporting the reinforcing mat in the plane shown on the Drawings.

H. Reinforcing shall not be straightened or bent unless specifically shown on the drawings. Bars with kinks or bends not shown on the Drawings shall not be used. Coiled reinforcement shall not be used.

I. Dowel Adhesive System shall be installed in strict conformance with the manufacturer's recommendations and as required in Article 2.04 above. A representative of the manufacturer must be on site prior to adhesive dowel installation to provide instruction on proper installation procedures for all adhesive dowel installers. Testing of adhesive dowels shall be as indicated below. If the dowels have a hook at the end to be embedded in subsequent work, an approved mechanical coupler shall be provided at a convenient distance from the face of existing concrete to facilitate adhesive dowel testing while maintaining required hook embedment in subsequent work.

J. All adhesive dowel installations in the horizontal or overhead orientation shall be conducted by a certified Adhesive Anchor Installer as certified by ACI/CSRI Adhesive Anchor Installer Certification program, or equivalent, per ACI 318-11 D.9.2.2 or ACI 318-14 17.8.2.2. Current AAI Certificates must be submitted to the Engineer for approval prior to commencement of any adhesive anchor installations.

K. Adhesive Dowel Testing

1. At all locations where adhesive dowels are shown on the Drawings, at least 5 percent of all adhesive dowels installed shall be tested to 80% of the yield load of the reinforcing bar, with a minimum of one tested dowel per group.

2. Contractor shall submit a plan and schedule indicating locations of dowels to be tested, load test values, and proposed dowel testing procedure (including a diagram of the testing equipment proposed for use) prior to conducting any testing. Proof testing procedures shall be in accordance with ASTM E 3121.

3. Where Contract Documents indicate adhesive dowel design is the Contractor's responsibility, the Contractor shall submit a plan and schedule indicating locations of dowels to be tested and load test values, sealed by a Professional Engineer currently registered in the State or Commonwealth in which the project is located. The Contractor shall also submit documentation indicating the Contractor's testing procedures have been reviewed and the proposed procedures are acceptable.

4. Adhesive Dowel shall have no visible indications of displacement or damage during or after the load test. Dowels exhibiting damage shall be removed and replaced. If more than 5 percent of tested dowels fail, then 100 percent of dowels shall be load tested.

5. Load testing of adhesive dowels shall be performed by an independent testing laboratory hired directly by the Contractor. The Contractor shall be responsible for costs of all testing, including additional testing required due to previously failed tests.

3.04 SPLICING

A. Reinforcing bar splices shall only be used at locations shown on the Drawings. When necessary to splice reinforcing at points other than where shown, the splice shall be as acceptable to the Engineer.

B. The length of lap for reinforcing bars, unless otherwise shown on the Drawings shall be in accordance with ACI 318 for a class B splice.

C. Laps of welded wire fabric shall be in accordance with ACI 318. Adjoining sheets shall be securely tied together with No. 14 tie wire, one tie for each 2 running feet. Wires shall be staggered and tied in such a manner that they cannot slip.

D. Mechanical splices shall be used only where shown on the drawings or when approved by the Engineer.

E. Couplers which are located at a joint face shall be a type which can be set either flush or recessed from the face as shown on the Drawings. The couplers shall be sealed during concrete placement to eliminate concrete, or cement paste from entering. After the concrete is placed, couplers intended for future connections shall be plugged and sealed

to prevent any contact with water or other corrosive materials. Threaded couplers shall be plugged with plastic plugs which have an O-ring seal.

3.05 INSPECTION

A. The Contractor shall advise the Engineer of their intentions to place concrete and shall allow the Engineer adequate time to inspect all reinforcing steel before concrete is placed.

B. The Contractor shall advise the Engineer of their intentions to place grout in masonry walls and shall allow the Engineer adequate time to inspect all reinforcing steel before grout is placed.

3.06 CUTTING OF EMBEDDED REBAR

A. The Contractor shall not cut embedded rebar cast into structural concrete without prior approval.

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SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. Provide all labor, equipment, materials, and services necessary for the manufacture, transportation, and placement of all plain and reinforced concrete work, as shown on the Drawings or as required by the Engineer.

B. The requirements in this section shall apply to the types of concrete listed below. See Article 2.09 for concrete mix design and properties of concrete.

1. Class A1 Concrete: Normal weight structural concrete to be used in all structures qualifying as environmental concrete structures designed in accordance with ACI 350 including pump stations, tanks, basins, process structures, and any structures containing fluid or process chemicals, or other materials used in treatment process.

2. Class A2 Concrete: Normal weight structural concrete in all structures other than environmental concrete structures as described above, and for all sidewalks and pavement.

3. Class A3 Concrete: Not Used

4. Class A4 Concrete: Normal weight structural concrete to be used where specifically called for on Contract Drawings or areas where specifically requested by Contractor and approved by Engineer. Class A4 concrete is identical to Class A2 concrete except that coarse aggregate specified in Article 2.08 below shall be Size #8 in accordance with ASTM C33.

5. Class A5 Concrete: Not Used

6. Class B Concrete: Normal weight structural concrete used for duct bank encasements, catch basins, fence and guard post embedment, concrete fill, and other areas where specifically noted on Contract Drawings.

7. Class C Concrete: Not Used.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 03 11 00 – Concrete Formwork

B. Section 03 21 00 – Reinforcing Steel

C. Section 03 15 00 – Concrete Accessories

D. Section 03 15 16 – Joints in Concrete

E. Section 03 35 00 – Concrete Finishes

F. Section 03 39 00 – Concrete Curing

G. Section 03 60 00 – Grout

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of the Specifications, all work herein shall conform to or exceed the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.

1. Florida Building Code

2. ACI 214 – Guide to Evaluation of Strength Test Results of Concrete

3. ACI 301 – Specifications for Structural Concrete

4. ACI 304 – Guide for Measuring, Mixing, Transporting, and Placing Concrete

5. ACI 305 – Specification for Hot Weather Concreting

6. ACI 306 – Standard Specification for Cold Weather Concreting

7. ACI 309R – Guide for Consolidation of Concrete

8. ACI 318 – Building Code Requirements for Structural Concrete and Commentary

9. ACI 350 – Code Requirements for Environmental Engineering Concrete Structures

10. ASTM C 31 – Standard Practice for Making and Curing Concrete Test Specimens in the Field

11. ASTM C 33 – Standard Specification for Concrete Aggregates

12. ASTM C 39 – Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

13. ASTM C42 – Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete

14. ASTM C 88 – Standard Test Method for Soundness of Aggregates by use of Sodium Sulfate or Magnesium Sulfate

15. ASTM C 94 – Standard Specification for Ready-Mixed Concrete

16. ASTM C 114 – Standard Test Method for Chemical Analysis of Hydraulic Cement

17. ASTM C 136 – Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates

18. ASTM C 138 – Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete

19. ASTM C 143 – Standard Test Method for Slump of Hydraulic Cement Concrete

20. ASTM C 150 – Standard Specification for Portland Cement

21. ASTM C 157 - Standard Test Method for Length Change of Hardened Hydraulic Cement, Mortar and Concrete

22. ASTM C 172 – Standard Practice for Sampling Freshly Mixed Concrete

23. ASTM C 192 – Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory

24. ASTM C 231 – Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method

25. ASTM C 260 – Standard Specification for Air-Entraining Admixtures for Concrete

26. ASTM C 295 – Standard Guide for Petrographic Examination of Aggregates for Concrete

27. ASTM C 457 – Standard Test Method for Microscopical Determination of the Air-Void System in Hardened Concrete

28. ASTM C 494 – Standard Specification for Chemical Admixtures for Concrete

29. ASTM C 595 – Standard Specification for Blended Hydraulic Cements

30. ASTM C 618 – Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete

31. ASTM C 989 – Standard Specification for Slag Cement for Use in Concrete and Mortars

32. ASTM C 1012 – Standard Test Method for Length Change of Hydraulic Cement Mortars Exposed to a Sulfate Solution

33. ASTM C 1077 – Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation

34. ASTM C 1157 – Standard Performance Specification for Hydraulic Cement

35. ASTM C 1260 – Test Method for Potential Alkali Reactivity of Aggregates (Mortar Bar Method)

36. ASTM C 1567 – Standard Test Method for Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method)

37. ASTM C 1579 – Standard Test Method for Evaluating Plastic Shrinkage Cracking of Restrained Fiber Reinforced Concrete (Using a Steel Form Insert)

38. ASTM C 1602 – Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete

39. ASTM C 1609 – Standard Test Method for Flexural Performance of Fiber Reinforced Concrete (Using Beam with Third-Point Loading)

40. ASTM C 1778 – Standard Guide for Reducing the Risk of Deleterious Alkali – Aggregate Reaction in Concrete

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittal Procedures.

1. Sources of all materials and certifications of compliance with specifications for all materials.

2. Certified current (less than 1 year old) chemical analysis (mill test report) of the Portland Cement or Blended Cement to be used. The chemical analysis must include the equivalent alkali content of the Portland Cement or Blended Cement. For Type IL cement, submit updated cement mill test reports every 6 months while active concrete work is being performed

3. Certified current (less than 1 year old) chemical analysis of fly ash or slag cement to be used.

4. Aggregate test results showing compliance with required standards, i.e., sieve analysis, aggregate soundness tests, etc.

5. Manufacturer's data on all admixtures stating compliance with required standards.

6. Concrete mix design for each class of concrete specified herein.

7. Field experience records and/or trial mix data for the proposed concrete mixes for each class of concrete specified herein.

1.05 QUALITY ASSURANCE

A. Tests on materials used in the production of concrete shall be required as specified in Part 2 – Products. These tests shall be performed by an independent testing laboratory approved by the Engineer at no additional cost to the Owner.

B. Trial concrete mixes shall be tested when required in accordance with Article 3.01 at no additional cost to the Owner.

C. Field quality control tests, as specified in Article 3.11, unless otherwise stated, will be performed by a materials testing consultant employed by the Owner. However, the Contractor shall be charged for the cost of any additional tests and investigation on work performed which does not meet the Specifications. Any individual who samples and tests concrete to determine if the concrete is being produced in accordance with this Specification shall be certified as a Concrete Field-Testing Technician, Grade I, in accordance with ACI CP-2. Testing laboratory shall conform to requirements of ASTM C-1077.

1.06 CONCRETE COORDINATION CONFERENCE

A. Unless waived by the Engineer, prior to any concrete submittals and at least 35 days prior to the start of the concrete construction schedule, the Contractor shall conduct a meeting at the site. The purpose of the meeting is to review the proposed concrete mix designs, to discuss the proposed approaches and procedures for mixing, transporting, placing, testing, finishing, and curing of all aspects of concrete work to ensure the concrete construction is performed in accordance with the Specifications, and to clarify roles of the parties involved. The Contractor shall send a concrete coordination conference agenda to all attendees 20 days prior to a mutually agreed upon date for the conference.

B. As a minimum the agenda shall include:

1. Concrete Materials and Mix Designs
2. Inspection Responsibilities
3. Concrete Sampling and Testing Specification Requirements
4. Cylinder Storage and Transportation
5. Acceptance/Rejection Responsibility and Authority for Fresh Concrete
6. Concrete finishing
7. Concrete Curing
8. Test Report Distribution
9. Miscellaneous Items

C. The Contractor shall require responsible representatives of every party who is concerned with the concrete work to attend the conference, including but not limited to the following:

1. Contractor's superintendent

2. Engineer

3. Owner's representative (if they chose to attend)

4. Laboratory retained for trial batching and construction quality control testing for the concrete.

5. Any subcontractors involved in placing, finishing, and curing of concrete

6. Concrete supplier

7. Concrete pumping subcontractor (if pumping is being proposed)

D. Minutes of the meeting shall be recorded, typed, and printed by the Contractor and distributed to all attendees and any other concerned parties within five days of the meeting.

PART 2 – PRODUCTS

2.01 HYDRAULIC CEMENT

A. Portland Cement

1. Portland Cement shall be Type II conforming to ASTM C 150. Type I cement may be used provided either fly ash or slag cement is also included in the mix in accordance with Articles 2.04 or 2.05, respectively.

2. The proposed Portland Cement shall not contain more than 8% tricalcium aluminate and more than 12% tetracalcium aluminoferrite.

3. Portland Cement shall also meet performance requirements of ASTM C 1157.

B. Blended Cement

1. Blended cements shall be Type IP (Portland Fly Ash Cement), Type IS (Portland Slag Cement), or Type IL (Portland Limestone Cement) conforming to ASTM C 595.

2. Type IP cement shall be an inter-ground blend of Portland Cement and fly ash in which the fly ash constituent is between 15% and 25% of the weight of the total blend.

3. Type IS cement shall be an inter-ground blend of Portland Cement and slag cement in which the slag cement constituent is between 30% and 40% of the weight of the total blend.

4. Type IL cement shall be an inter-ground blend of Portland Cement and limestone in which the limestone constituent is between 5% and 15% of the weight of the total blend.

5. Fly ash, slag cement, and limestone used in the production of blended cements shall meet the requirements of Articles 2.02, 2.03, and 2.04 respectively.

6. Cements meeting ASTM C 1157 shall not be used in manufacture of blended cements.

7. Blended cement shall meet the Physical Requirements of Tables 2 and 3 of ASTM C 595 including the requirements for high sulfate resistance in Table 3 as tested per ASTM C1012.

C. Different types of cement shall not be mixed, nor shall they be used alternately except when authorized in writing by the Engineer. Different brands of cement or the same brand from different mills may be used alternately. A resubmittal will be required if different cements are proposed during the Project.

D. Cement shall be stored in a suitable weather-tight building to prevent deterioration or contamination. Cement which has become caked, partially hydrated, or otherwise damaged will be rejected.

2.02 FLY ASH

A. Fly ash shall meet the requirements of ASTM C 618 for Class F, except that the loss on ignition shall not exceed 4%. Fly ash shall also meet the optional physical requirements for uniformity as shown in Table 3 of ASTM C 618. Fly ash shall be considered as a supplemental cementitious material.

B. For fly ash to be used in the production of Type IP cement, the Pozzolan Activity Index shall be greater than 75% as specified in Table 3 of ASTM C 595.

C. Where fly ash is used, the minimum fly ash content shall be 15%.

D. For Type A1 concrete as required for use in environmental concrete structures, i.e., process structures or fluid containing structures, inclusion of fly ash or slag cement in the concrete mix, is mandatory.

E. Additional fly ash shall not be included in concrete mixed with Type IS or IP cement.

2.03 SLAG CEMENT

A. Slag cement shall meet the requirements of ASTM C 989.

B. Where Slag Cement is used, the minimum Slag Cement content shall be 30%, and the maximum Slag Cement content shall be 40%.

C. For Type A1 concrete as required for use in environmental concrete structures, i.e., process structures or fluid containing structures, inclusion of fly ash or slag cement in the concrete mix, is mandatory.

D. Additional slag cement shall not be included in concrete mixed with Type IS or IP cement.

2.04 PORTLAND LIMESTONE CEMENT (TYPE IL)

A. Portland Limestone Cement (Type IL) cement shall meet the requirements of ASTM C 595.

B. Limestone used for blended cement Type IL shall be naturally occurring and meet the requirements of ASTM C 33.

C. Fly ash or slag cement shall be used with Type IL cement to meet requirements for durability, sulfate resistance, and use for environmental structures, as specified herein.

2.05 WATER

A. Water used for mixing concrete shall be clear, potable, and free from deleterious substances such as objectionable quantities of silty organic matter, alkali, salts, and other impurities.

B. Water shall not contain more than 100 PPM chloride.

C. Water shall not contain more than 500 PPM dissolved solids.

D. Water shall have a pH in the range of 4.5 to 8.5.

E. Water shall meet requirements of ASTM C 1602.

2.06 AGGREGATES

A. All aggregates used in normal weight concrete shall conform to ASTM C 33.

B. Fine Aggregate (Sand) in the various concrete mixes shall consist of natural or manufactured siliceous sand, clean and free from deleterious substances, and graded within the limits of ASTM C 33.

C. Coarse aggregates shall consist of hard, clean, durable gravel, crushed gravel, or crushed rock. Coarse aggregate shall be size #57 or #67 as graded within the limits given in ASTM C 33 unless otherwise specified.

D. For Class A4 concrete, coarse aggregate shall be Size #8 in accordance with ASTM C33.

E. Aggregates shall be tested for gradation by sieve analysis tests in conformance with ASTM C 136.

F. Aggregates shall be tested for soundness in accordance with ASTM C 88. The loss resulting after five cycles shall not exceed 10 percent for fine or coarse aggregate when using either magnesium sulfate or sodium sulfate.

G. Contractor shall submit a new trial mix to the Engineer for approval whenever a different aggregate or gradation is proposed.

2.07 SYNTHETIC FIBERS

A. Micro-synthetic fibers shall meet requirements of ASTM C 1116 and shall provide a minimum cracking reduction ratio (CRR) of 40 percent when tested in accordance with ASTM C 1579. Acceptable products are MasterFiber F Series or M Series by Master Builders Solutions, or equal. Micro-synthetic fibers shall be included in cement grout mixes where grout topping is to be swept into place by equipment mechanism.

B. Macro-synthetic fibers shall meet the requirements of ASTM C 1116 and shall have a minimum equivalent flexural strength ratio of 25 percent when tested in accordance with ASTM C 1609. Acceptable products are MasterFiber MAC Series by Master Builders Solutions, Tuf Strand SF by the Euclid Chemical Company, Strux 90/40 by W.R. Grace, or equal.

C. Fibers shall be used only where specifically required on Contract Drawings or where specifically approved by Engineer.

2.08 ADMIXTURES

A. Admixtures containing intentionally added chlorides shall not be used.

B. Admixtures containing 1,4 Dioxane shall not be used.

C. Air entraining admixture shall be added to all concrete unless noted otherwise. The air entraining admixture shall conform to ASTM C 260. The admixture proposed shall be selected in advance so that adequate samples may be collected, and the required tests made. Air content of concrete, when placed, shall be within the ranges given in the concrete mix design.

D. The following admixtures are required or used for water reduction, slump increase, and/or adjustment of initial set, and enhancing durability. Admixtures permitted shall confirm to

the requirements of ASTM C 494. Admixtures shall be non-toxic after 30 days and shall be compatible with and made by the same manufacturer as the air-entraining admixtures.

1. Water reducing admixture shall conform to ASTM C 494, Type A and shall contain no more than 0.05% chloride ions. Acceptable products are “Eucon Series” by the Euclid Chemical Company, “Master Pozzolith Series or Master Polyheed Series” by Master Builders Solutions, and “Plastocrete Series” by Sika Corporation.

2. High range water reducer shall conform to ASTM C 494, Type F or G. The high range water reducer shall be added to the concrete at the batch plant and may be used in conjunction with a water reducing admixture. The high range water reducer shall be accurately measured, and pressure injected into the mixer as a single dose by an experienced technician. A standby system shall be provided and tested prior to each day’s operation of the job site system. Concrete shall be mixed at mixing speed for a minimum of 100 mixer revolutions after the addition of the high range water reducer. Acceptable products are “Eucon 37” or Plastol 5000 by the Euclid Chemical Company, “Master Rheobuild 1000 or Master Glenium Series” by Master Builders Solutions, and “Daracem 100 or Advaflow Series” by W.R. Grace.

3. A non-chloride, non-corrosive accelerating admixture may be used where specifically approved by the Engineer. The admixture shall conform to ASTM C 494, Type C or E. The admixture manufacturer must have long-term non-corrosive test data from an independent testing laboratory (of at least a year’s duration) using an acceptable accelerated corrosion test method such as that using electrical potential measures. Acceptable products are “MasterSet AC 534 or MasterSet FP 20” by Master Builders Solutions, “Accelguard 80/90 or NCA” by the Euclid Chemical Company and “Daraset” by W.R. Grace.

4. A retarding admixture may be used where specifically approved by the Engineer. The admixture shall conform to ASTM C494, Type B or D. Acceptable products are “Eucon NR or Eucon Retarder 100” by the Euclid Chemical Company, “MasterSet R Series or MasterSet DELVO Series” by Master Builders Solutions, and “Plastiment” by Sika Corporation.

5. Workability Retaining Admixture shall conform to ASTM C 494, Type S. The admixture shall retain concrete workability without affecting time of setting or early-age strength development. Acceptable products are “MasterSure Z 60” by Master Builders Solutions, or equal.

6. A crystalline permeability reducing admixture shall be used where specifically indicated on the Drawings or required herein. The admixture shall conform to ASTM C 494, Type S. The admixture shall be of the crystalline type that chemically controls and permanently establishes a non-soluble crystalline structure throughout the capillary voids and cracks within the concrete. The crystalline structure shall assist in sealing the concrete to minimize both infiltration and exfiltration of liquids from any direction. The admixture shall be capable of sealing hairline cracks and resisting

hydrostatic pressure. Acceptable products are “Xypex Admix C-500 NF” by Xypex Chemical Corporation, “MasterLife® 300 Series” by Master Builders Solutions, and “Krystol Internal Membrane (KIM)” by Kryton International Inc. Submit certified letter from manufacturer of crystalline admixture stating required dosage rate for job specific concrete mix. Concrete truck ticket shall confirm crystalline admixture was included in concrete being placed.

E. Admixtures containing calcium chloride, thiocyanate or more than 0.05 percent chloride ions are not permitted. The addition of admixtures to prevent freezing is not permitted.

F. The Contractor shall submit manufacturer's data including the chloride ion content of each admixture and certification from the admixture manufacturer that all admixtures utilized in the design mix are compatible with one another and properly proportioned prior to mix design review.

2.09 CONCRETE MIX DESIGN

A. The proportions of cement, aggregates, admixtures, and water used in the concrete mixes shall be based on laboratory trial mixes in conformance with ACI 301. Trial mixes shall also conform to Article 3.01 of this Specification. Trial mix data used as the basis for the proposed concrete mix design shall be submitted to the Engineer along with the proposed mix.

B. Structural concrete shall conform to the following requirements. Cementitious materials refer to the total combined weight of all cement, fly ash, and slag cement contained in the mix.

1. Compressive Strength (28-Day)

Concrete Class A1	4,500 psi (min.), 6500 psi (max.)
Concrete Class A2, A4	4,000 psi (min.), 6000 psi (max.)
Concrete Class B	3,000 psi (min.), 5000 psi (max.)

2. Water/cementitious materials ratio, by weight

	Maximum	**Minimum**
Concrete Class A1	0.42	0.39
Concrete Class A2, A4	0.45	0.39
Concrete Class B	0.50	0.39

3. Slump range

a. 4" nominal unless high range water reducing admixture is used

b. 8” max if high range water reducing admixture is used.

4. Air Content

Concrete Class A1, A2, A4	6% ±1.5%
Concrete Class B	3% Max (non-air-entrained)

PART 3 – EXECUTION

3.01 TRIAL MIXES

A. Trial mixes shall be used to confirm the quality of a proposed concrete mix in accordance with ACI 301. An independent qualified testing laboratory designated and retained by the Contractor shall test a trial batch of each of the preliminary concrete mixes submitted by the Contractor. The trial batches shall be prepared using the aggregates, cement, supplementary cementitious materials, and admixtures proposed for the project. The trial batch materials shall be of a quantity such that the testing laboratory can obtain enough samples to satisfy requirements stated below. Tests on individual materials stated in PRODUCTS should already be performed before any trial mix is done. The cost of laboratory trial batch tests for each specified concrete mix will be borne by the Contractor and the Contractor shall furnish and deliver the materials to the testing laboratory at no cost to the Owner.

B. The independent testing laboratory shall prepare a minimum of fifteen (15) standard test cylinders in accordance with ASTM C 31 in addition to conducting slump (ASTM C 143), air content (C 231) and density (C 138) tests. Compressive strength test on the cylinders shall subsequently be performed by the same laboratory in accordance with ASTM C 39 as follows: Test 3 cylinders at age 7 days; test 3 cylinders at age 21 days; test 3 cylinders at age 28 days and test 3 cylinders at 56 days. The cylinders shall be carefully identified as "Trial Mix, Contract No. “. If the average 28-day compressive strength of the trial mix is less than that specified, or if any single cylinder falls below the required strength by more than 500 psi, the mix shall be corrected, another trial batch prepared, test cylinders taken, and new tests performed as before. Any such additional trial batch testing required shall be performed at no additional cost to the Owner. Adjustments to the mix shall be considered refinements to the mix design and shall not be the basis for extra compensation to the Contractor.

3.02 FIELD EXPERIENCE RECORDS

A. When field experience records are provided in lieu of trial mixes for proposed concrete mixes, field experience records shall meet the following criteria:

1. Field experience records shall have been obtained within the past 24 months from project Notice to Proceed and shall have occurred over a duration of no less than 45 calendar days.

2. Field experience records shall be based on data from a single group of at least 15 consecutive compressive strength tests or two groups of consecutive compressive strength tests totaling at least 30 tests with neither of the two groups consisting of fewer than 10 tests.

3. Concrete for field experience records shall have the same mix proportions and properties as the proposed concrete mix, including compressive strength and air content within a range of 4.5% to 7.5%.

4. Concrete for field experience records shall have identical material sources as the proposed concrete mix. These materials shall include cement, fly ash, slag cement, coarse aggregates, fine aggregates, and admixtures.

5. If all criteria for field experience records cannot be met, the contractor shall perform trial mixes for the proposed concrete mixes.

3.03 PRODUCTION OF CONCRETE

A. All concrete shall be machine mixed. Hand mixing of concrete will not be permitted. The Contractor may supply concrete from a ready-mix concrete plant or from a site mixed plant. In selecting the source for concrete production, the Contractor shall carefully consider its capability for providing quality concrete at a rate commensurate with the requirements of the placements so that well bonded, homogenous concrete, free of cold joints, is assured.

B. Ready-Mixed Concrete

1. At the Contractor's option, ready-mixed concrete may be used meeting the requirements for materials, batching, mixing, transporting, and placing as specified herein and in accordance with ASTM C 94.

2. Truck mixers shall be equipped with electrically actuated counters by which the number of revolutions of the drum or blades may be readily verified. The counter shall be of the resettable, recording type, and shall be mounted in the driver's cab. The counters shall be actuated at the time of starting mixers at mixing speeds.

3. Each batch of concrete shall be mixed in a truck mixer for not less than 100 revolutions of the drum or blades at the rate of rotation designated by the manufacturer of equipment. Additional mixing, if any, shall be at the speed designated by the manufacturer of the equipment as agitating speed. All materials including mixing water shall be in the mixer drum before actuating the revolution counter for determining the number of revolutions of mixing.

4. Truck mixers and their operation shall be such that the concrete throughout the mixed batch, as discharged, is within acceptable limits of uniformity with respect to consistency, mix and grading. If slump tests taken at approximately the 1/4 and 3/4 points of the load during discharge give slumps differing by more than one inch when the specified slump is 3 inches or less, or if they differ by more than 2 inches when the specified slump is more than 3 inches, the mixer shall not be used on the work unless the causing condition is corrected and satisfactory performance is verified by additional slump tests. All mechanical details of the mixer, such as water measuring and discharge apparatus, condition of the blades, speed of rotation, general mechanical condition of the unit and clearance of the drum, shall be checked before a further attempt to use the unit will be permitted.

5. Ready-mixed concrete shall be delivered to the site for the work and discharge shall be completed within the time requirements stated in Article 3.04 of this Section.

6. Every concrete delivery shall be accompanied by a delivery ticket containing at least the following information:

    a. Date and truck number

    b. Ticket number

    c. Mix designation of concrete

    d. Cubic yards of concrete

    e. Cement brand, type, and weight in pounds

    f. Weight in pounds of fine aggregate (sand)

    g. Weight in pounds of coarse aggregate (stone)

    h. Air entraining agent, brand, and weight in pounds and ounces

    i. Other admixtures, brand, and weight in pounds and ounces

    j. Water, in gallons, stored in attached tank

    k. Water, in gallons, maximum that can be added without exceeding design water/cementitious materials ratio

    l. Water, in gallons, used (by truck driver)

    m. Time of loading

    n. Time of delivery to job (by truck driver)

7. Any truck delivering concrete to the job site, which is not accompanied by a delivery ticket showing the above information will be rejected and such truck shall immediately depart from the job site.

8. The use of non-agitating equipment for transporting ready-mixed concrete will not be permitted. Combination truck and trailer equipment for transporting ready-mixed concrete will not be permitted. The quality and quantity of materials used in ready-mixed concrete and in batch aggregates shall be subject to inspection at the batching plant by the Engineer.

C. Site Mixed Concrete

1. Site Mixed Concrete shall only be used where specifically approved by the Engineer

2. Scales for weighing concrete ingredients shall be accurate when in use within ±0.4 percent of their total capacities. Standard test weights shall be available to permit checking scale accuracy.

3. Operation of batching equipment shall be such that the concrete ingredients are consistently measured within the following tolerances:

a.	Cement, fly ash, or slag cement	± 1 percent
b.	Water	± 1 percent
c.	Aggregates	± 2 percent
d.	Admixtures	± 3 percent

4. Each batch shall be so charged into the mixer that some water will enter in advance of the cement and aggregates. Water shall continue for a period which may extend to the end of the first 25 percent of the specified mixing time. Controls shall be provided to prevent batched ingredients from entering the mixer before the previous batch has been completely discharged.

5. The concrete shall be mixed in a batch mixer capable of thoroughly combining the aggregates, cement, and water into a uniform mass within the specified mixing time, and of discharging the concrete without harmful segregation. The mixer shall bear a manufacturer's rating plate indicating the rate capacity and the recommended revolutions per minute and shall be operated in accordance therewith.

6. Mixers with a rated capacity of one cubic yard or larger shall conform to the requirements of the Plant Mixer Manufacturers' Division of the Concrete Plant Manufacturers' Bureau.

7. Except as provided below, batches of one cubic yard or less shall be mixed for not less than one minute. The mixing time shall be increased 15 seconds for each cubic yard or fraction thereof of additional capacity.

8. Shorter mixing time may be permitted provided performance tests made in accordance with of ASTM C 94 indicate that the time is sufficient to produce uniform concrete.

9. Controls shall be provided to ensure that the batch cannot be discharged until the required mixing time has elapsed. At least three-quarters of the required mixing time shall take place after the last of the mixing water has been added.

10. The interior of the mixer shall be free of accumulations that will interfere with mixing action. Mixer blades shall be replaced when they have lost 10 percent of their original height.

11. Air-entraining admixtures and other chemical admixtures shall be charged into the mixer as solutions and shall be measured by means of an approved mechanical dispensing device. The liquid shall be considered a part of the mixing water. Admixtures that cannot be added in solution may be weighed or may be measured by volume if recommended by the manufacturer.

12. If two or more admixtures are used in the concrete, they shall be added separately to avoid possible interaction that might interfere with the efficiency of either admixture or adversely affect the concrete.

13. Addition of retarding admixtures shall be completed within one minute after addition of water to the cement has been completed, or prior to the beginning of the last three-quarters of the required mixing, whichever occurs first. Retarding admixtures shall not be used unless approved by the Engineer.

14. Concrete shall be mixed only in quantities for immediate use and within the time and mixing requirements of ASTM C 94.

3.04 CONCRETE PLACEMENT

A. No concrete shall be placed prior to approval of the concrete mix design. Concrete placement shall conform to the recommendations of ACI 304.

B. Prior to concrete placement, all reinforcement shall be securely and properly fastened in its correct position. Formwork shall be clean, oiled and form ties at construction joints shall be retightened. All bucks, sleeves, castings, hangers, pipe, conduits, bolts, anchors, wire, and any other fixtures required to be embedded therein shall be in place. Forms for openings to be left in the concrete shall be in place and anchored by the Contractor. All loose debris in bottoms of forms or in keyways shall be removed and all debris, water, snow, ice, and foreign matter shall be removed from the space to be occupied by the

concrete. The Contractor shall notify the Engineer in advance of placement, allowing sufficient time for a concurrent inspection and for any corrective measures required.

C. On horizontal joints where concrete is to be placed on hardened concrete, flowing concrete containing a high range water reducing admixture or cement grout shall be placed with a slump not less than 8 inches for the initial placement at the base of the wall. Concrete or cement grout shall meet all strength and service requirements specified herein for applicable class of concrete. This concrete shall be worked well into the irregularities of the hard surface.

D. All concrete shall be placed during the daylight hours except with the consent of the Engineer. If special permission is obtained to carry on work during the night, adequate lighting must be provided.

E. When concrete arrives at the project with slump below that suitable for placing, as indicated by the Specifications, water may be added to bring the concrete within the specified slump range provided the design water-cementitious materials ratio is not exceeded. The water shall be incorporated by additional mixing equal to at least half of the total mixing required. Water may be added only to full trucks. On-site tempering shall not relieve the Contractor from furnishing a concrete mix meeting all specified requirements.

F. Concrete shall be conveyed as rapidly as practical to the point of deposit by methods which prevent the separation or loss of the ingredients. The concrete shall be deposited so that additional handling will be unnecessary. Discharge of the concrete to its point of deposit shall be completed within 90 minutes after the addition of the cement to the aggregates unless workability-retaining admixtures are included and approved by the Engineer. In hot weather, or under conditions contributing to quick stiffening of the concrete, the time between the introduction of the cement to the aggregates and discharge shall not exceed the requirements stated in Article 3.09 of this Section.

G. Where concrete is conveyed to position by chutes, a continuous flow in the chute shall be maintained. The angle and discharge arrangement of the chute shall be such to prevent segregation of the concrete ingredients. The delivery end of the chute shall be as close as possible to the point of deposit and in no case shall the free pour from the delivery end of the chute exceed five feet, unless approved otherwise.

H. Special care must be exercised to prevent splashing of forms or reinforcement with concrete, and any such splashes or accumulations of hardened or partially hardened concrete on the forms or reinforcement above the general level of the concrete already in place must be removed before the work proceeds.

I. Placing of concrete shall be regulated so the pressure caused by the wet concrete shall not exceed that used in the design of the forms.

J. All concrete for walls shall be placed through openings in the form spaced at frequent intervals or through tremies (heavy duct canvas, rubber, etc.), equipped with suitable hopper heads. Tremies shall be of variable lengths so the free fall shall not exceed five (5) feet, and enough tremies shall be placed in the form to ensure the concrete remains level.

K. When placing concrete which will be exposed, sufficient illumination shall be provided in the interior of the forms so the concrete, at places of deposit, is visible from deck and runways.

L. Concrete shall be placed to thoroughly embed all reinforcement, inserts, and fixtures.

M. When forms are removed, surfaces shall be even and dense, free from aggregate pockets or honeycomb. Concrete shall be consolidated using mechanical vibration, supplemented by forking and spading by hand in the corners and angle of forms and along form surfaces while the concrete is plastic under the vibratory action. Consolidation shall conform to ACI 309.

N. Mechanical vibration shall be applied directly to the concrete, unless otherwise approved by the Engineer. The bottom of vibrators used on floor slabs must not be permitted to ride the form supporting the slab. Vibration shall be applied at the point of deposit and in freshly placed concrete by a vertical penetration of the vibrator. Vibrators shall not be used to move concrete laterally within the forms.

O. The intensity of vibration shall be sufficient to cause settlement of the concrete into place and to produce monolithic joining with the preceding layer. Vibration shall be of sufficient duration to accomplish thorough compaction and complete embedment of reinforcement and fixtures with a vibrator transmitting not less than 7,500 impulses per minute. Since the duration of vibration per square foot of surface is dependent on the frequency (impulses per minute), size of vibrator, and slump of concrete, the length of time must therefore be determined in the field. Vibration shall not be continued in any one location to the extent that pools of grout are formed.

P. Care shall be taken to prevent cold joints when placing concrete in any portion of the work. The concrete placing rate shall ensure that each layer is placed while the previous layer is soft or plastic, so the two layers can be made monolithic by penetration of the vibrators. Maximum thickness of concrete layers shall be 18 inches. The surface of the concrete shall be level whenever a run of concrete is stopped.

Q. To prevent featheredges, construction joints located at the tops of horizontal lifts near sloping exposed concrete surfaces shall be inclined near the exposed surface, so the angle between such inclined surface and the exposed concrete surface will be not less than 50°.

R. In placing unformed concrete on slopes, the concrete shall be placed ahead of a non-vibrated slip-form screed extending approximately 2-1/2 feet back from its leading edge.

The method of placement shall provide a uniform finished surface with the deviation from the straight line less than 1/8 inch in any concrete placement. Concrete ahead of the slip-form screed shall be consolidated by internal vibrators to ensure complete filling under the slip-form. Prior to placement of concrete on sloped walls or slabs, the Contractor shall submit a plan specifically detailing methods and sequence of placements, proposed concrete screed equipment, location of construction joints and water stops, and/or any proposed deviations from the stated requirements to the Engineer for review and approval.

S. Concrete shall not be placed during rains sufficiently heavy or prolonged to prevent washing of mortar from coarse aggregate on the forward slopes of the placement. Once placement of concrete has commenced in a block, placement shall not be interrupted by diverting the placing equipment to other uses.

3.05 PLACING FLOOR SLABS ON GROUND

A. The subgrade for slabs on ground shall be well drained and of adequate and uniform loadbearing nature. The in-place density of the subgrade soils shall be at least the minimum required by the specifications. No foundation, slab, or pavement concrete shall be placed until the depth and character of the foundation soils have been inspected and approved by the materials testing consultant.

B. The subgrade shall be free of frost before concrete placing begins. If the temperature inside a building where concrete is to be placed is below freezing, the temperature shall be raised and maintained above 50° long enough to remove all frost from the subgrade.

C. The subgrade shall be moist at the time of concreting. If necessary, the subgrade shall be dampened with water in advance of concreting, but no free water shall remain standing on the subgrade nor any muddy or soft spots when the concrete is placed.

D. Thirty-pound felt-paper shall be provided between edges of slabs-on-ground and vertical and horizontal concrete surfaces, unless otherwise indicated on the Drawings.

E. Contraction joints shall be provided in slabs-on-ground at locations indicated on the Drawings. Contraction joints shall be installed as per Section 03 15 16 – Joints in Concrete.

F. Floor slabs shall be screeded level or pitched to drain as indicated on the Drawings. Finishes shall conform with requirements of Section 03 35 00 – Concrete Finishes. Interior floor slabs shall be placed with non-air-entrained concrete (Class A3) if a steel troweled or hardened finish is required.

3.06 PLACING CONCRETE UNDER PRESSURE

A. Where concrete is conveyed and placed by mechanically applied pressure, the equipment shall have the capacity for the operation. The operation of the pump shall produce a continuous stream of concrete without air pockets. To obtain the least line resistance, the

layout of the pipeline system shall contain minimum bends with no change in pipe size. If two sizes of pipe must be used, the smaller diameter should be used at the pump end and the larger at the discharge end. When pumping is completed, the concrete remaining in the pipelines shall be ejected in such a manner that there will be no contamination of the concrete or separation of the ingredients.

B. Priming of the concrete pumping equipment shall be with cement grout only. Use of specialty mix pump primers or pumping aids will not be allowed.

C. No aluminum parts shall be in contact with the concrete during the placing of concrete under pressure.

D. Prior to placing concrete under pressure, the Contractor shall submit the concrete mix design together with test results from a material's testing consultant proving the proposed mix meets all requirements. In addition, an actual pumping test under field conditions is required prior to acceptance of the mix. This test requires a duplication of anticipated site conditions from beginning to end. The batching and truck mixing shall be the same as will be used during construction, and the pipe and pipe layouts will reflect the maximum height and distance contemplated. All submissions shall be subject to approval by the Engineer.

E. If the pumped concrete does not produce satisfactory end results, the Contractor shall discontinue the pumping operation and proceed with the placing of concrete using conventional methods.

F. The pumping equipment must have two cylinders and be designed to operate with one cylinder only in case the other one is not functioning. In lieu of this requirement, the Contractor may have a standby pump on the site during pumping.

G. The minimum diameter of the hose (conduits) shall be four inches.

H. Pumping equipment and hoses (conduits) that are not functioning properly shall be replaced.

I. Concrete samples for quality control in accordance with Article 3.10 will be taken at the placement (discharge) end of the line.

3.07 ORDER OF PLACING CONCRETE

A. To minimize the effects of shrinkage, the concrete shall be placed in units as bounded by construction joints shown on the Drawings and maximum lengths as indicated on Drawings. Where required on the Drawings and wherever else practical, the placing of such units shall be done in a strip pattern in accordance with ACI 302.1. A minimum of 72 hours shall pass prior to placing concrete directly adjacent to previously placed concrete.

3.08 CONCRETE WORK IN COLD WEATHER

A. Cold weather concreting procedures shall conform to the requirements of ACI 306.1.

B. The Engineer may prohibit the placing of concrete at any time when air temperature is 40°F. or lower. If concrete work is permitted, the concrete shall have a minimum temperature, as placed, of 55°F. for placements less than 12" thick, 50°F. for placements 12" to 36" thick, and 45°F. for placements greater than 36" thick. The temperature of the concrete as placed shall not exceed these minimum values by more than 20°F, unless otherwise approved by the Engineer.

C. All aggregate and water shall be preheated. Precautions shall be taken to avoid the possibility of flash set when aggregate or water are heated to a temperature greater than 100°F. to meet concrete temperature requirements. The addition of admixtures to the concrete to prevent freezing is not permitted. All reinforcement, forms, and concrete accessories shall be defrosted by an approved method. No concrete shall be placed on frozen ground.

3.09 CONCRETE WORK IN HOT WEATHER

A. Hot weather concreting procedures shall conform to the requirements of ACI 305.1.

B. When air temperatures exceed 85°F., or when extremely dry or high wind conditions exist even at lower temperatures, the Contractor and the Contractor’s concrete supplier shall exercise special and precautionary measures in preparing, delivering, placing, finishing, curing, and protecting the concrete mix. The Contractor shall consult with the Engineer regarding such measures prior to each day's placing operation, and the Engineer reserves the right to modify the proposed measures consistent with the requirements herein. All necessary materials and equipment shall be in place prior to each placing operation.

C. Preparatory work at the job site shall include thorough wetting of all forms, reinforcing steel and, in the case of slab pours on ground or subgrade, spraying the ground surface on the preceding evening and again just prior to placing. No standing puddles of water shall be permitted in those areas which are to receive the concrete.

D. The temperature of the concrete mix when placed shall not exceed 95°F.

E. Temperature of mixing water and aggregates shall be carefully controlled and monitored at the supplier's plant, with haul distance to the job site being considered. Stockpiled aggregates shall be shaded from the sun and sprinkled intermittently with water. If ice is used in the mixing water for cooling purposes, the ice must be entirely melted prior to addition of the water to the dry mix.

F. Delivery schedules shall be carefully considered in advance to ensure concrete is placed as soon as practical after mixing. For hot weather concrete work (air temperature greater than 85°F), discharge of the concrete to its point of deposit shall be completed within 60 minutes from the time the concrete is batched, unless workability-retaining admixtures are included and approved by the Engineer.

G. The Contractor shall arrange for an ample work force to be on hand to accomplish transporting, vibrating, finishing, and covering of the fresh concrete as rapidly as possible.

3.10 QUALITY CONTROL

A. Field Testing of Concrete

1. The Contractor shall coordinate with the Engineer's project representative the on-site scheduling of the materials testing consultant personnel as required for concrete testing.

2. Concrete for testing shall be supplied by the Contractor at no additional cost to the Owner, and the Contractor shall assist the materials testing consultant in obtaining samples. The Contractor shall dispose of and clean up all excess material.

B. Consistency

1. The consistency of the concrete will be checked by the materials testing consultant by standard slump cone tests. The Contractor shall make any necessary adjustments in the mix as the Engineer and/or the materials testing consultant may direct and shall upon written order suspend all placing operations in the event the consistency does not meet the intent of the specifications. No payment shall be made for any delays, material, or labor costs due to such occurrences.

2. Slump tests shall be made in accordance with ASTM C 143. Slump tests will be performed as deemed necessary by the materials testing consultant and each time compressive strength samples are taken.

3. Concrete with a specified nominal slump shall be placed having a slump within 1” (higher or lower) of the specified slump. Concrete with a specified maximum slump shall be placed having a slump less than the specified slump.

C. Density

1. Samples of freshly mixed concrete shall be tested for density by the materials testing consultant in accordance with ASTM C 138.

2. Density tests will be performed as deemed necessary by the Engineer and each time compressive strength samples are taken.

D. Air Content

1. Samples of freshly mixed concrete will be tested for entrained air content by the materials testing consultant in accordance with ASTM C 231.

2. Air content tests will be performed as deemed necessary by the materials testing consultant and each time compressive strength samples are taken.

3. In the event test results are outside the limits specified, additional testing shall occur. Admixture quantity adjustments shall be made immediately upon discovery of incorrect air entrainment.

E. Compressive Strength

1. Samples of freshly mixed concrete will be taken by the materials testing consultant and tested for compressive strength in accordance with ASTM C 172, C 31, and C 39, except as modified herein.

2. In general, one sampling shall be taken for each placement more than five (5) cubic yards, with a minimum of one (1) sampling for each day of concrete placement operations, or for each one hundred (100) cubic yards of concrete, or for each 5,000 square feet of surface area for slabs or walls, whichever is greater.

3. Each sampling shall consist of at least five (5) 6x12 cylinders or (8) 4x8 cylinders. Each cylinder shall be identified by a tag, which shall be hooked or wired to the side of the container. The materials testing consultant will fill out the required information on the tag, and the Contractor shall satisfy themselves that such information shown is correct.

4. The Contractor shall be required to furnish labor to the Owner for assisting in preparing test cylinders. The Contractor shall provide approved curing boxes for storage of cylinders on site. The insulated curing box shall be of sufficient size and strength to contain all the cylinders made in any four consecutive working days and to protect the specimens from falling over, being jarred, or otherwise disturbed during the period of initial curing. The box shall be erected, furnished, and maintained by the Contractor. Such box shall be equipped to provide the moisture and to regulate the temperature necessary to maintain the proper curing conditions required by ASTM C 31. The curing box shall be placed in an area free from vibration such as pile driving and traffic of all kinds and such that all cylinders are shielded from direct sunlight and/or radiant heating sources. No concrete requiring testing shall be delivered to the site until such storage curing box has been provided. Cylinders shall remain undisturbed in the curing box until ready for delivery to the testing laboratory, but not less than sixteen hours.

5. The Contractor shall be responsible for maintaining the temperatures of the curing box during the initial curing of cylinders with the temperature preserved between 60°F and 80°F as measured by a maximum-minimum thermometer. The Contractor shall maintain a written record of curing box temperatures for each day the curing box contains cylinders. Temperature shall be recorded a minimum of three times a day with one recording at the start of the day and one recording at the end of the day.

6. When transported, the cylinders shall not be thrown, dropped, allowed to roll, or be damaged in any way.

7. Compression tests shall be performed in accordance with ASTM C 39. For 6x12 cylinders, two test cylinders will be tested at seven days and two at 28 days. For 4x8 cylinders, three test cylinders will be tested at seven days, three at 28 days. The remaining cylinders will be held to verify test results, if needed.

F. Evaluation and Acceptance of Concrete

1. Evaluation and acceptance of the compressive strength of concrete shall be according to the requirements of ACI 214, ACI 318, and ACI 350.

2. The strength level of concrete will be considered satisfactory if the following conditions are satisfied.

   a. Every arithmetic average of any three consecutive strength tests equals or exceeds the minimum specified 28-day compressive strength for the mix (see Article 2.11).

   b. No individual compressive strength test result falls below the minimum specified strength by more than 500 psi.

3. If any of the conditions listed above are not met, the mix proportions shall be corrected for the next concrete placing operation.

4. If condition 3.09.F.2.b is not met, additional tests in accordance with Article 3.09, Paragraph H shall be performed.

5. When a ratio between 7-day and 28-day strengths has been established by these tests, the 7-day strengths shall subsequently be taken as a preliminary indication of the 28-day strengths. Should the 7-day test strength from any sampling be more than 10% below the established minimum strength, the Contractor shall:

   a. Immediately provide additional periods of curing in the affected area from which the deficient test cylinders were taken.

   b. Maintain or add temporary structural support as required.

   c. Correct the mix for the next concrete placement operation, if required to remedy the situation.

6. All concrete which fails to meet the ACI requirements, and these specifications is subject to removal and replacement at no additional cost to the Owner.

G. When non-compliant concrete is identified, test reports shall be sent immediately to the Engineer for review.

H. Additional Tests

1. When ordered by the Engineer, additional tests on in-place concrete shall be provided and paid for by the Contractor.

2. If the 28-day test cylinders fail to meet the minimum strength requirements as outlined in Article 3.09, Paragraph F, the Contractor shall have concrete core specimens obtained and tested from the affected area immediately.

    a. Three cores shall be taken for each sample in which the strength requirements were not met.

    b. The drilled cores shall be obtained and tested in conformance with ASTM C 42. The tests shall be conducted by a materials testing consultant approved by the Engineer.

    c. The location from which each core is taken shall be approved by the Engineer. Each core specimen shall be located, when possible, so its axis is perpendicular to the concrete surface and not near formed joints or obvious edges of a unit of deposit.

    d. The core specimens shall be taken, if possible, so no reinforcing steel is within the confines of the core.

    e. The diameter of core specimens should be at least 3 times the maximum nominal size of the coarse aggregate used in the concrete but must be at least 2-inches in diameter.

    f. The length of specimen, when capped, shall be at least twice the diameter of the specimen.

    g. The core specimens shall be taken to the laboratory and when transported, shall not be thrown, dropped, allowed to roll, or damaged in any way.

    h. Two (2) copies of test results shall be mailed directly to the Engineer. The concrete in question will be considered acceptable if the average compressive strength of a minimum of three test core specimens taken from a given area equal or exceed 85% of the specified 28-day strength and if the lowest core strength is greater than 75% of the specified 28-day strength.

3. If the concrete placed by the Contractor is suspected of not having proper air content, the Contractor shall engage a materials testing consultant approved by the Engineer, to obtain and test samples for air content in accordance with ASTM C 457.

3.11 CARE AND REPAIR OF CONCRETE

A. The Contractor shall protect all concrete against injury or damage from excessive heat, lack of moisture, overstress, or any other cause until final acceptance by the Owner. Care

shall be taken to prevent the drying of concrete and to avoid roughening or otherwise damaging the surface. Care shall be exercised to avoid jarring forms or placing any strain on the ends of projecting reinforcing bars. Any concrete found to be damaged, or which may have been originally defective, or which becomes defective at any time prior to the final acceptance of the completed work, or which departs from the established line or grade, or which, for any other reason, does not conform to the requirements of the Contract Documents, shall be satisfactorily repaired or removed and replaced with acceptable concrete at no additional cost to the Owner.

B. Areas of honeycomb shall be chipped back to sound concrete and repaired as directed.

C. Concrete formwork blowouts or unacceptable deviations in tolerances for formed surfaces due to improperly constructed or misaligned formwork shall be repaired as directed. Bulging or protruding areas, which result from slipping or deflecting forms shall be ground flush or chipped out and redressed as directed.

D. Areas of concrete in which cracking, spalling, or other signs of deterioration develop prior to final acceptance shall be removed and replaced or repaired as directed. This stipulation includes concrete that has experienced cracking due to drying or thermal shrinkage of the concrete. Structural cracks shall be repaired using an approved epoxy injection system. Non-structural cracks shall be repaired using an approved hydrophilic resin pressure injected grout system unless other means of repair are deemed necessary and approved. All repair work shall be performed at no additional cost to the Owner.

E. Concrete which fails to meet the strength requirements as outlined in Article 3.09, Paragraph F, will be analyzed as to its adequacy based upon loading conditions, resultant stresses, and exposure conditions for the area of concrete in question. If the concrete in question is found unacceptable based upon this analysis, that portion of the structure shall be strengthened or replaced by the Contractor at no additional cost to the Owner. The method of strengthening or extent of replacement shall be as directed by the Engineer.

END OF SECTION

SECTION 03 35 00
CONCRETE FINISHES

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. Furnish all materials, labor, and equipment required to provide finishes of all concrete surfaces specified herein and shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 03 11 00 – Concrete Formwork

B. Section 03 30 00 – Cast-in-Place Concrete

C. Section 03 60 00 – Grout

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.

1. ACI 301 – Specifications for Structural Concrete for Buildings

2. ACI 318 – Building Code Requirements for Structural Concrete

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittal Procedures.

1. Manufacturer's literature on all products specified herein.

PART 2 – PRODUCTS

2.01 CONCRETE FLOOR SEALER

A. Floor sealer shall be Diamond Clear VOX or Super Diamond Clear VOX by the Euclid Chemical Company, MasterKure CC 300 SB by Master Builders Solutions.

2.02 CONCRETE LIQUID DENSIFIER AND SEALANT

A. Concrete liquid densifier and sealant shall be a high performance, deeply penetrating concrete densifier and sealant. Product shall be odorless, colorless, VOC-compliant, non-yellowing siliconate based solution designed to harden, dustproof, and protect concrete floors subjected to heavy vehicular traffic and to resist black rubber tire marks on concrete surfaces. The product must contain a minimum solids content of 20% of which 50% is siliconate. Acceptable products are Diamond Hard by the Euclid Chemical Company, and Seal Hard by L&M Construction Chemicals, and Masterkure HD 200 WB by Master Builders Solutions.

2.03 NON-OXIDIZING HEAVY DUTY METALLIC FLOOR HARDENER

A. Non-oxidizing heavy-duty metallic floor hardener shall be formulated, processed, and packaged under stringent quality control at the manufacturer's owned and controlled factory. The hardener shall be a mixture of specifically processed non-rusting aggregate, selected Portland cement, and necessary plasticizing agents. Product shall be "Diamond-Plate" by the Euclid Chemical Company, or MasterTop 200 by Master Builders Solutions.

2.04 NON-SLIP FLOORING ADDITIVE

A. Non-slip flooring additives for slip resistant floors shall be non-metallic. Non-slip flooring additives shall be MasterTop 120SR by Master Builders Solutions, A-H Alox by Anti-Hydro, or Euco Grip by the Euclid Chemical Company.

PART 3 – EXECUTION

3.01 FINISHES ON FORMED CONCRETE SURFACES

A. After removal of forms, the finishes described below shall be applied in accordance with Article 3.06 - Concrete Finish Schedule. Unless the finish schedule specifies otherwise, all surfaces shall receive at least a Type I finish. See Article 3.05 for surfaces to receive paint or protective coatings. The Engineer shall be the sole judge of acceptability of all concrete finish work.

1. Type I - Rough: All fins, burrs, offsets, marks, and all other projections left by the forms shall be removed. Projections, depressions, etc. below finished grade required to be removed will only be those greater than ¼-inch. All holes left by removal of ends of ties, and all other holes, depressions, bug holes, air/blow holes or voids shall be filled solid with cement grout after first being thoroughly wetted and then struck off flush. The only holes below grade to be filled will be tie holes and any other holes larger than ¼-inch in any dimension. Honeycombs shall be chipped back to solid concrete and repaired as directed by the Engineer. All holes shall be filled with tools, such as sponge floats and trowels, that will permit packing the hole solidly with cement grout. Cement grout shall consist of one-part cement to three parts

sand, epoxy bonding agent (for tie holes only) and the amount of mixing water shall be as little as consistent with the requirements of handling and placing. Color of cement grout shall match the adjacent wall surface.

2. Type II - Grout Cleaned: Where this finish is required, it shall be applied after completion of Type I finish. After the concrete has been pre-dampened over an extended amount of time to reach the condition of saturated surface dry (SSD), a slurry consisting of one part cement (including an appropriate quantity of white cement to produce a color matching the surrounding concrete) and 1-1/2 parts sand passing the No. 16 sieve, by damp loose volume, shall be spread over the surface with clean burlap pads or sponge rubber floats. Mix proportions shall be submitted to the Engineer after a sample of the work is established and accepted. Any surplus shall be removed by scraping and then rubbing with clean burlap.

3. Type III - Smooth Rubbed: Where this finish is required, it shall be applied after the completion of the Type II finish. No rubbing shall be done before the concrete is thoroughly hardened and the mortar used for patching is firmly set. A smooth, uniform surface shall be obtained by wetting the surface and rubbing with a carborundum stone to eliminate irregularities. Unless the nature of the irregularities requires it, the general surface of the concrete shall not be cut into. Corners and edges shall be slightly rounded using a carborundum stone. Brush finishing or painting with grout or neat cement will not be permitted. A 100 square foot example shall be established at the beginning of the project to establish acceptability.

3.02 SLAB AND FLOOR FINISHES

A. The finishes described below shall be applied to floors, slabs, flow channels and top of walls in accordance with Article 3.05 - Concrete Finish Schedule. The Engineer shall be the sole judge of acceptability of all such finish work.

1. Type "A" - Screeded: This finish shall be obtained by placing screeds at frequent intervals and striking off to the surface elevation required. When a Type "F" finish is subsequently to be applied, the surface of the screeded concrete shall be roughened with a concrete rake to 1/2” minimum deep grooves prior to final set.

2. Type "B" - Wood or Magnesium Floated: This finish shall be obtained after completion of a Type "A" finish by working a previously screeded surface with a wood or magnesium float or until the desired texture is reached. Floating shall begin when the water sheen has disappeared and when the concrete has sufficiently hardened so that a person's foot leaves only a slight imprint. If wet spots occur, water shall be removed with a squeegee. Care shall be taken to prevent the formation of laitance and excess water on the finished surface. All edges shall be edged with an 1/8-inch tool as directed by the Engineer. The finished surface shall be true, even, and free from blemishes and any other irregularities.

3. Type "C" - Cork Floated: This finish shall be similar to Type "B" but slightly smoother than the finish obtained with a wood float. The finish shall be obtained by power or band floating with cork floats.

4. Type "D" - Steel Troweled: This finish shall be obtained after completion of a Type "B" finish. When the concrete has hardened sufficiently to prevent excess fine material from working to the surface, the surface shall be compacted and smoothed with not less than two thorough and complete steel troweling operations. In areas which are to receive a floor covering such as tile, resilient flooring, or carpeting, the applicable Specification Sections and Contract Drawings shall be reviewed for the required finishes and degree of flatness. In areas that are intermittently wet such as pump rooms, only one troweling operation is required to provide some trowel marks for slip resistance. All edges shall be edged with an 1/8-inch tool as directed by the Engineer. The finish shall be brought to a smooth, dense surface, free from defects and blemishes.

5. Type "E" - Broom or Belt: This finish shall provide the surface with a transverse scored texture by drawing a broom or burlap belt across the surface immediately after completion of a Type "B" finish. All edges shall be edged with an 1/8-inch tool as directed by the Engineer.

6. Type "F" - Swept in Grout Topping: This finish shall be applied after a completion of a Type "A" finish. The concrete surface shall be properly cleaned, washed, and coated with a mixture of water and Portland Cement. Cement grout with inclusion of micro-synthetic fibers in accordance with Section 03 60 00 – Grout shall be plowed and swept into neat conformance with the blades or arms of the apparatus by turning or rotating the previously positioned mechanical equipment. Special attention shall be paid to true grades, shapes and tolerances as specified by the manufacturer of the equipment. Before beginning this finish, the Contractor shall notify the Engineer and the equipment manufacturer of the details of the operation and obtain approval and recommendations.

   Type “G” Hardened Finish: This finish shall be applied after completion of a Type “B” or Type “C” finish and prior to application of a Type “D” finish. Hardeners shall be applied in strict accordance with the manufacturer’s requirements. Hardeners shall be applied using a mechanical spreader. The hardener shall be applied in two shakes with the first shake comprising 2/3 of the total amount. Type “D” finish shall be applied following completion of application of the hardener. Non-oxidizing, heavy-duty metallic floor hardener shall be applied at the loading docks and where specifically required on the Contract Drawings or specified herein at the rate of 1.5 pounds/ft.2.

7. Type "H" - Non-Slip Finish: This finish shall be provided by applying a non-slip flooring additive concurrently with the application of a Type "D" finish and/or installation of floor sealants. Application procedure shall be in accordance with

manufacturer's instructions. Finish shall be applied where specifically required on the Contract Drawings or specified herein.

8. Type "J" - Raked Finish: This finish shall be provided by raking the surface as soon as the condition of the concrete permits by making depressions of ±1/4 inch.

3.03 CONCRETE SEALERS

A. Concrete sealers shall be applied where specifically required on the Contract Drawings or specified herein. Concrete sealers and densifiers shall not be used as concrete curing compounds. Curing compounds, when allowed, shall be in accordance with Section 03 39 00 – Concrete Curing.

B. Sealers shall be applied after installation of all equipment, piping, etc. and after completion of any other related construction activities. Application of sealers shall be in strict accordance with manufacturer’s requirements.

C. Sealers shall be applied to all floor slabs not painted and not intended to be immersed.

D. Floor slabs subjected to vehicular traffic shall be sealed with the concrete liquid densifier and sealer.

E. All other floor slabs to receive sealer shall be sealed with concrete floor sealer.

3.04 FINISHES ON EQUIPMENT PADS

A. Formed surfaces of equipment pads shall receive a Type III finish.

B. Top surfaces of equipment pads, except those surfaces subsequently required to receive grout and support equipment bases, shall receive a Type "D" finish, unless otherwise noted. Surfaces which will later receive grout shall, before the concrete takes its final set, be made rough by removing the sand and cement that accumulates on the top to the extent that the aggregate will be exposed with irregular indentations in the surface up to 1/2 inch deep.

3.05 FINISHES FOR SURFACES TO RECEIVE PAINT OR COATINGS

A. Surfaces indicated or specified to receive paint or special coatings shall be prepared per specifications in Division 09. All products applied to the concrete surfaces during the placement, finishing, and curing process shall be compatible with the painting or coating system as required by the manufacturer.

3.06 CONCRETE FINISH SCHEDULE

Item	Type of Finish
Inner face of walls of tanks, flow channels, wet wells, perimeter walls, and miscellaneous concrete structures:	
From 1 feet below water surface to bottom of wall	I
From top of wall to 1 feet below water surface	II
Exterior concrete walls below grade	I
Exterior exposed concrete walls, ceilings, beams, manholes, hand holes, miscellaneous structures, and columns (including top of wall) to one foot below grade. All other exposed concrete surfaces not specified elsewhere	II
All interior exposed concrete walls and vertical surfaces	III
Interior exposed ceiling, including beams	III
Floors of process equipment tanks or basins, wetwells, flow channels and slabs to receive roofing material or waterproof membranes	B
All interior finish floors of buildings and structures and walking surfaces which will be continuously or intermittently wet	E
All interior finish floors of buildings and structures which are not continuously or intermittently wet	D
Floors to receive tile, resilient flooring, or carpeting	D
Exterior concrete sidewalks, steps, ramps, decks, slabs on grade and landings exposed to weather	E
Garage, storage area floors, and loading docks	G
Precast concrete form panels, hollow core planks, double tees	J

END OF SECTION

SECTION 03 39 00
CONCRETE CURING

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. Protect all freshly deposited concrete from premature drying and from the weather elements. The concrete shall be maintained with minimal moisture loss at a relatively constant temperature for a period necessary for the hydration of the cement and proper hardening of the concrete in accordance with the requirements specified herein.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 03 11 00 – Concrete Formwork

B. Section 03 30 00 – Cast-In-Place Concrete

C. Section 03 35 00 – Concrete Finishes

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.

1. ACI 301 – Specifications for Structural Concrete

2. ACI 304 – Guide for Measuring, Mixing, Transporting, and Placing Concrete

3. ACI 305.1 – Specification for Hot Weather Concreting

4. ACI 306.1 – Standard Specification for Cold Weather Concreting

5. ACI 308.1 – Specification for Curing Concrete

6. ASTM C171 – Standard Specifications for Sheet Materials for Curing Concrete

7. ASTM C309 – Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete

8. ASTM C1315 – Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittal Procedures.

1. Proposed procedures for protection of concrete under wet weather placement conditions.

2. Proposed normal procedures for protection and curing of concrete.

3. Proposed special procedures for protection and curing of concrete under hot and cold weather conditions.

4. Proposed method of measuring concrete surface temperature changes.

5. Manufacturer's literature and material certification for proposed curing compounds.

PART 2 – PRODUCTS

2.01 LIQUID MEMBRANE-FORMING CURING COMPOUND

A. Clear curing and sealing compound shall be a clear styrene acrylate type complying with ASTM C 1315, Type 1, Class A with a minimum solids content of 30%. Moisture loss shall not be greater than 0.40 kg/m2 when applied at manufacturer’s recommended volume for square feet of area. Manufacturer’s certification is required. Acceptable products are Super Diamond Clear VOX by the Euclid Chemical Company.

B. Where specifically approved by Engineer, on slabs to receive subsequent applied finishes, compound shall conform to ASTM C 309. Acceptable products are “Kurez DR VOX” or “Kurez W VOX” by the Euclid Chemical Company. Install in strict accordance with manufacturer’s requirements.

2.02 EVAPORATION REDUCER

A. Evaporation reducer shall be "MasterKure ER 50” by Master Builders Solutions, or "Euco-Bar" by Euclid Chemical Company.

PART 3 – EXECUTION

3.01 PROTECTION AND CURING

A. All freshly placed concrete shall be protected from the elements, flowing water and from defacement of any nature during construction operations.

B. As soon as the concrete has been placed and horizontal top surfaces have received their required finish, provisions shall be made for maintaining the concrete in a moist condition for at least a 7-day period thereafter, except for high early strength concrete, for which the

period shall be at least the first three days after placement. Horizontal surfaces shall be kept covered, and intermittent, and localized drying will not be permitted.

C. Walls that will be exposed on one side with either fluid or earth backfill on the opposite side shall be continuously wet cured for a minimum of seven days. Use of a curing compound will not be acceptable for applications of this type.

D. The Contractor shall use one of the following methods to ensure that the concrete remains in a moist condition for the minimum period stated above.

1. Ponding or continuous fogging or sprinkling.

2. Application of mats or fabric kept continuously wet.

3. Continuous application of steam (under 150°F).

4. Application of sheet materials conforming to ASTM C171.

5. If approved by the Engineer, application of a curing compound in accordance with Article 3.04.

E. The Contractor shall keep absorbent wood forms wet until they are removed. After form removal, the concrete shall be cured by one of the methods in paragraph D.

F. Any of the curing procedures used in Paragraph 3.01-D may be replaced by one of the other curing procedures listed in Paragraph 3.01-D after the concrete is one-day old. However, the concrete surface shall not be permitted to become dry at any time.

3.02 CURING CONCRETE UNDER COLD WEATHER CONDITIONS

A. Suitable means shall be provided for a minimum of 72 hours after placing concrete to maintain it at or above the minimum as placed temperatures specified in Section 03 30 00 – Cast-In-Place Concrete, for concrete work in cold weather. During the 72-hour period, the concrete surface shall not be exposed to air more than 20°F above the minimum as placed temperatures.

B. Stripping time for forms and supports shall be increased as necessary to allow for retardation in concrete strength caused by colder temperatures. This retardation is magnified when using concrete made with blended cements or containing fly ash or slag cement. Therefore, curing times and stripping times shall be further increased as necessary when using these types of concrete.

C. The methods of protecting the concrete shall be approved by the Engineer and shall be such as will prevent local drying. Equipment and materials approved for this purpose shall be on the site in sufficient quantity before the work begins. The Contractor shall assist the Engineer by providing holes in the forms and the concrete in which thermometers can be

placed to determine the adequacy of heating and protection. All such thermometers shall be furnished by the Contractor in quantity and type which the Engineer directs.

D. Curing procedures during cold weather conditions shall conform to the requirements of ACI 306.

3.03 CURING CONCRETE UNDER HOT WEATHER CONDITIONS

A. When air temperatures exceed 85°F, the Contractor shall take extra care in placing and finishing techniques to avoid formation of cold joints and plastic shrinkage cracking. If ordered by the Engineer, temporary sunshades and/or windbreakers shall be erected to guard against such developments, including generous use of wet burlap coverings and fog sprays to prevent drying out of the exposed concrete surfaces.

B. Immediately after screeding, horizontal surfaces shall receive an application of evaporation reducer. Apply in accordance with manufacturer's instructions. Final finish work shall begin as soon as the mix has stiffened sufficiently to support the workmen.

C. Curing and protection of the concrete shall begin immediately after completion of the finishing operation. Continuous moist-curing consisting of method 1 or 2 listed in paragraph 3.01D is mandatory for at least the first 24 hours. Method 2 may be used only if the finished surface is not marred or blemished during contact with the coverings.

D. At the end of the initial 24-hour period, curing and protection of the concrete shall continue for at least six (6) additional days using one of the methods listed in paragraph 3.01D.

E. Curing procedures during hot weather conditions shall conform to the requirements of ACI 305.

3.04 USE OF CURING COMPOUND

A. Curing compound shall be used only where specifically approved by the Engineer. Curing compound shall never be used for curing exposed walls with fluid or earth backfill on the opposite side. A continuous wet cure for a minimum of seven days is required for these applications. Curing compound shall not be used on surfaces exposed to water in potable water storage tanks and treatment plants unless curing compound is certified in accordance with ANSI/NSF Standard 61.

B. When permitted, the curing compound shall maintain the concrete in a moist condition for the required time, and the subsequent appearance of the concrete surface shall not be affected.

C. The compound shall be applied in strict accordance with the manufacturer's recommendations after water sheen has disappeared from the concrete surface and after finishing operations. Coverage rates for the curing and sealing compound shall be in strict accordance with manufacturer’s requirements for the specific type of finish required. For rough surfaces, apply in two directions at right angles to each other.

END OF SECTION

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SECTION 03 40 00
PRECAST CONCRETE

PART 1 – GENERAL

1.01 REQUIREMENTS

A. The Contractor shall construct all precast concrete items as required in the Contract Documents, including all appurtenances necessary to make a complete installation.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 33 05 61 – Utility Structures

B. Section 03 21 00 – Reinforcing Steel

C. Section 03 30 00 – Cast-in-Place Concrete

D. Section 03 35 00 – Concrete Finishes

E. Section 03 39 00 – Concrete Curing

F. Section 03 60 00 – Grout

G. Section 05 10 00 – Metal Materials

H. Section 05 05 13 – Galvanizing

I. Section 05 05 23 – Metal Fastening

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of other requirements of these Specifications, all work specified herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of the Bid.

1. Florida Building Code

2. ACI 301 – Structural Concrete for Buildings

3. ACI 318 – Building Code Requirements for Structural Concrete

4. ASTM D2240 – Standard Test for Rubber Property – Durometer Hardness

5. PCI Standard MNL-116 – Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products

6. PCI Standard MNL-120 - Design Handbook Precast and Prestressed Concrete

7. PCI Standard MNL-123 – Manual on Design of Connections for Precast Prestressed Concrete

8. PCI Standard MNL-124 – PCI Design for Fire Resistance of Precast Prestressed Concrete

1.04 SUBMITTALS

A. The Contractor shall submit the following for review in accordance with Section 01 33 00 – Submittal Procedures.

1. Shop Drawings for all precast members including layout and dimensions, unit locations, unit identification marks, reinforcement connection details, support items, dimensions, openings, temporary supports, and relationship to adjacent materials. Indicate design loads, deflections, cambers, bearing requirements, and special conditions. The submittal shall be sealed by a Professional Engineer currently registered in the State of Florida.

2. A list of the design criteria used by the manufacturer for all manufactured, precast items.

3. Design calculations, showing at least the design loads and stresses on the item and assumptions, shall be submitted. Calculations shall be sealed by a Professional Engineer currently registered in the in the State of Florida.

4. Certified reports for all lifting inserts, indicating allowable design loads.

5. Information on lifting and erection procedures.

1.05 QUALITY ASSURANCE

A. All manufactured precast concrete units shall be produced by an experienced manufacturer regularly engaged in the production of such items. All manufactured precast concrete and site-cast units shall be free of defects, spalls, and cracks. Care shall be taken in the mixing of materials, casting, curing, and shipping to avoid any of the above. The Engineer may elect to examine the units at the casting yard or upon arrival of the same at the site. The Engineer shall have the option of rejecting any or all the precast work if it does not meet with the requirements specified herein or on the Drawings. All rejected work shall be replaced at no additional cost to the Owner.

B. Manufacturer Qualifications: The precast concrete manufacturing plant shall be certified by the Prestressed Concrete Institute, Plant Certification Program, prior to the start of

production. Certification is required for plants providing prestressed structural members such as hollow core planks, double-T members, etc.

C. Plant production and engineering must be under direct supervision and control of an Engineer who possesses a minimum of five years' experience in precast concrete work.

D. Erector of precast and prestressed items shall be a company specializing in erecting members specified with a minimum of three years documented experience and specifically approved by the fabricator of precast and prestressed members specified.

PART 2 – PRODUCTS

2.01 DESIGN REQUIREMENTS

A. Precast and prestressed members shall be designed to support superimposed loads indicated on the Drawings and as required by current Florida Building Code. Design shall also consider loads and stresses due to handling, transporting, and erecting of units.

B. Maximum live load deflections for members shall be L/240 for roof members and L/360 for floor members.

C. Members shall be designed to accommodate construction tolerances, and clearances of intended openings.

D. Design shall be performed by a qualified professional engineer registered in the State or Commonwealth in which the project is located.

E. Fire Rating shall be established in accordance with PCI MNL 124 to achieve the fire ratings required on the Drawings for floor, wall, and roof assemblies.

2.02 CONCRETE

A. Concrete materials including Portland cement, aggregates, water, and admixtures shall conform to Section 03 30 00 – Cast-in-Place Concrete. Precast concrete manufacturer has option of using Type III cement for prestressed concrete members to expedite release of prestressing and erection.

B. For prestressed concrete items, minimum compressive strength of concrete at 28 days shall be 5,000 psi unless otherwise specified. Minimum compressive strength of concrete at transfer of prestressing force shall be 3,500 psi unless otherwise specified.

C. For non-prestressed concrete items, minimum compressive strength of concrete at 28 days shall be 4,500 psi for fluid containing and other environmental concrete structures and 4,000 for other structural concrete structures, unless otherwise specified.

2.03 GROUT

A. Grout for joints between members shall be a cement grout in conformance with Section 03 60 00 – Grout.

B. Minimum compressive strength of grout at 7 days shall be 3,000 psi.

2.04 REINFORCING STEEL

A. Reinforcing steel used for precast concrete construction shall conform to Section 03 21 00 – Reinforcing Steel.

2.05 PRESTRESSING STRANDS

A. Prestressing strands shall be 7-wire, stress-relieved, high-strength strands Grade 250K or 270K.

2.06 STEEL INSERTS

A. Steel inserts shall be in accordance with Section 05 10 00 – Metal Materials.

B. All steel inserts protruding from or occurring at the surface of precast units shall be galvanized in accordance with Section 05 05 13 – Galvanizing.

2.07 WELDING

A. Welding shall conform to Section 05 05 23 – Metal Fastening.

2.08 BEARING PADS

A. Neoprene bearing pads shall conform to the requirements of A4-F3-T.063-B2, Grade 2, Method B, in accordance with the RMA Rubber Handbook. Pads shall be nonlaminated pads having a nominal Shore A durometer hardness of 70 in accordance with ASTM D2240. Adhesive for use with neoprene pads shall be an epoxy-resin compound compatible with the neoprene having a sufficient shear strength to prevent slippage between pads and adjacent bearing surfaces. Adhesive shall be 20+F Contact Cement by Miracle Adhesives Corporation, Neoprene Adhesive 77-198 by IGI Adhesives, Sikadur 31, Hi-Mod Gel by Sika Corporation, or DP-605 NS Urethane Adhesive by 3M Adhesive Systems.

B. Plastic bearing pads shall be multi-monomer plastic strips which are non-leaching and support construction loads with no visible overall expansion, manufactured specifically for the purpose of bearing precast concrete.

PART 3 – EXECUTION

3.01 FABRICATION AND CASTING

A. All precast members shall be fabricated and cast to the shapes, dimensions and lengths shown on the Drawings and in compliance with PCI MNL-116. Precast members shall be straight, true, and free from dimensional distortions, except for camber and tolerances permitted later in this clause. All integral appurtenances, reinforcing, openings, etc., shall be accurately located and secured in position. Form materials shall be steel and the systems free from leakage during the casting operation.

B. Manufacturer shall maintain plant records and quality control program during production of precast members.

C. Ensure reinforcing steel anchors, inserts, plates, angles, and other cast-in items are embedded and located as indicated on shop drawings.

D. Openings with a 10-inch minimum dimension in either direction shall be cast in place. Smaller openings shall be considered in the design and arrangement of reinforcement and strands. These openings may be field cut, but only in the size and location approved by the precast manufacturer.

E. All cover of reinforcing shall be the same as detailed on the Drawings.

F. Because of the critical nature of the bond development length in prestressed concrete panel construction, if the transfer of stress is by burning of the fully tensioned strands at the ends of the member, each strand shall first be burned at the ends of the bed and then at each end of each member before proceeding to the next strand in the burning pattern.

G. The Contractor shall coordinate the communication of all necessary information concerning openings, sleeves, or inserts to the manufacturer of the precast members.

H. Concrete shall be finished in accordance with Section 03 35 00 – Concrete Finishes. Grout all recesses due to cut tendons which will not otherwise be grouted during erection.

I. Curing of precast members shall be in accordance with Section 03 39 00 – Concrete Curing. Use of a membrane curing compound will not be allowed.

J. The manufacturer shall provide lifting inserts or other approved means of lifting members.

3.02 HANDLING, TRANSPORTING AND STORING

A. Precast members shall not be transported away from the casting yard until the concrete has reached the minimum required 28-day compressive strength and a period of at least 5 days has elapsed since casting.

B. No precast member shall be transported from the plant to the job site prior to approval of that member by the plant inspector. This approval will be stamped on the member by the plant inspector.

C. During handling, transporting, and storing, precast concrete members shall be lifted and supported only at the lifting or supporting points as indicated on the shop drawings.

D. All precast members shall be stored on solid, unyielding, storage blocks in a manner to prevent torsion, objectionable bending, and contact with the ground.

E. Precast concrete members shall not be used as storage areas for other materials or equipment.

F. Precast members damaged while being handled or transported will be rejected or shall be repaired in a manner approved by the Engineer.

3.03 ERECTION

A. Erection shall be carried out by the manufacturer or under the manufacturer's supervision using labor, equipment, tools, and materials required for proper execution of the work.

B. Contractor shall prepare all bearing surfaces to a true and level line prior to erection. All supports of the precast members shall be accurately located and of required size and bearing materials.

C. Installation of the precast members shall be made by leveling the top surface of the assembled units keeping the units tight and at right angles to the bearing surface.

D. Connections which require welding shall be properly made in accordance with Section 05 05 23 – Metal Fastening.

E. Grouting between adjacent precast members and along the edges of the assembled precast members shall be accomplished as indicated on the drawings, care being taken to solidly pack such spaces and to prevent leakage or droppings of grout through the assembled precast members. Any grout which seeps through the precast members shall be removed before it hardens.

F. In no case shall concentrated construction loads, or construction loads exceeding the design loads, be placed on the precast members. In no case shall loads be placed on the precast members prior to the welding operations associated with erection, and prior to placing of topping (if required).

G. No Contractor, Subcontractor or any of their employees shall arbitrarily cut, drill, punch or otherwise tamper with the precast members.

H. Precast members damaged while being erected will be rejected or shall be repaired in a manner approved by the Engineer.

END OF SECTION

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SECTION 03 48 00
PRECAST CONCRETE SPECIALTIES

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The CONTRACTOR shall furnish all materials, labor, equipment, and tools required for the design, fabrication, delivery, and installment of precast concrete trenches, manhole vaults and meter box structures in accordance with the Drawings and as specified herein.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 03 40 00 – Precast Concrete

1.03 SUBMITTALS

A. The CONTRACTOR shall submit samples and/or shop drawings and in accordance with Section 01 33 00 – Submittal Procedures.

B. In addition to items listed in Section 03 40 00 – Precast Concrete, Shop Drawings shall include, but not be limited to:

1. Piping and conduit sheets.

2. Complete layout and installation drawings and schedules with clearly marked dimensions.

1.04 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Without limiting the generality of the other requirements of the Specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.

1. Federal Specification No. SS-5-00210.

2. ASTM C478 – Specification for Precast Reinforced Concrete Manhole Sections.

PART 2 – PRODUCTS

2.01 PRECAST MANHOLES, VAULTS, AND METER BOXES

A. Precast concrete manholes shall be furnished with waterstops, sleeves and openings as noted on the Drawings. Box out for wall pipes shall conform accurately to the sizes and elevations of the adjoining pipes. Precast manholes shall be watertight and conform to the

requirements of ASTM C-478 with reinforcing steel of ASTM A615, Grade 60 bars and the following modifications there to:

1. Materials shall conform to Section 03 40 00 – Precast Concrete.

2. The minimum wall thickness shall be 8 inches.

3. The date and time of manufacturer shall be marked inside each precast sections.

4. No more than two lift holes may be cast or drilled in each section.

5. Dimensions shall be as shown on the Drawings.

6. Vault covers and frames shall comply with Section 05 50 00 – Metal Fabrications. The frames and covers shall be provided by the vault manufacturer. Covers shall have lifting handles and shall be bolted with stainless steel bolts complying with Section 05 05 23 – Metal Fastening. When leveling bolts are used to set the vault top sections, the Contractor shall ensure that the load on the vault will be transferred through the mortar to the vault and will not be carried by the leveling bolts.

7. Mechanical details such as piping, electrical, and other details shall be as shown on the Drawings.

B. Joints between manhole riser sections and at base slabs shall be groove type. Joints shall be sealed with two (2) individual self-sealing butyl rubber gaskets conforming to Federal Specification No. SS-5-00210. The gasket material shall be Kent Seal.

2.02 PIPE CONNECTIONS

A. The precast reinforced concrete manhole base shall be provided with circular openings at the locations and elevations for the proper connection of all pipes. The pipe connections shall be sealed with either a flexible manhole seal assembly or with mortar.

B. When a flexible manhole seal assembly is used to seal the pipe connection, the seal assembly shall be installed in accordance with the recommendations of the seal assembly manufacturer and shall conform to ASTM C923.

C. Flexible manhole seal assemblies shall permit at least an eight (8) degree deflection from the center line of the opening in any direction while maintaining a watertight connection.

D. The flexible manhole seal assembly shall be manufactured by Interpace Corp (Lock Joint Flexible Manhole Sleeve), National Pollution Control Systems, Inc. (Kor-N-Seal) or Press-Seal Gasket Corp. Manhole seal assemblies produced by other manufacturers will be considered for use by ENGINEER if submitted by the CONTRACTOR. Such manhole seal assemblies shall be acceptable only if the Shop Drawings are approved.

E. Short lengths of sewer pipe shall be installed entering and leaving the precast manhole base. These short lengths of pipe shall have a maximum length of 3'3". A concrete cradle shall be placed under the short length of pipe in accordance with the dimensions shown on the Drawings.

F. The concrete cradle is not necessary when a flexible manhole seal assembly is used.

2.03 PRECAST CONCRETE TRENCH SYSTEM

A. Concrete trench system shall be provided to house sodium hydroxide (caustic), sodium hypochlorite, fluorosilicic acid (fluoride), ammonium sulfate, corrosion inhibitor, antiscalant and waste CIP cleaning solution chemical transfer and feed piping within the water treatment plant site in locations as shown on the Contract Documents.

B. The trench system will consist of precast concrete U-shaped bases and removable covers, manufactured by Trenwa or equal, and installed in earth trenches with covers matching adjacent concrete surfaces and asphalt pavement, or extending above surrounding sod or crushed rock surface where applicable.

C. The precast components shall be designed to conform to requirements stated in ASTM C857-19 “Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures”, ASTM C858-07 “Specifications for Underground Precast Concrete Utility Structures” and ACI-318 “Building Code Requirements for Structural Concrete and Commentary on Building Code Requirements in Structural Concrete”.

D. All sections of trench designated for road crossing use shall be designed to carry HS-20, 32,000-pound axle loading. The interior clear cross section area for the road crossing bases shall be at least 20-inches wide and 16-inches deep. The lids for road crossing trench shall be made of steel reinforced concrete designed to carry HS-20, 32,000-pound axle loading.

E. All sections of trench designated for pedestrian traffic, parking lots, and non-deliberated heavy vehicular traffic shall be designed to sustain loading of pickup trucks and light duty utility vehicles without damage. The interior clear cross section area for the tranches shall be at least 10-inches wide and 12-inches deep.

F. The precast trench system shall be designed and constructed so that neither the covers, nor temporary side-to-side braces need to be installed to facilitate installation or subsequent machine backfilling and tamping.

G. Trench system installation shall be performed in accordance with Section 31 00 01 – Earthwork, Section 31 23 00 – Excavation and Backfill for Utilities, Section 32 12 00 – Asphalt Concrete Pavement, and with manufacturer’s recommendations.

2.04 MANHOLE LADDERS

A. Manhole ladders shall conform to Section 06 51 00 – Glass Fiber and Resin Fabrications.

PART 3 – EXECUTION

3.01 DESIGN CRITERIA

A. Precast items subjected to vehicular traffic shall be designed for H-20 traffic loading. Other precast items shall be designed for a vertical live load of 300 psf.

B. Walls of precast items shall be designed for a vertical surcharge of 100 psf.

3.02 MANUFACTURED ITEMS

A. Precast concrete manhole sections shall be set so as to be vertical, with sections in true alignment. The joint of the previously set section shall be covered with mortar and preformed joint sealant before the next section is placed. Before the mortar is set, joints shall be pointed, and exterior joints shall be thoroughly tooled so as to be slightly concave with a hard polished surface, free of cracks. Interior joints shall be tooled flush in a similar manner.

B. Precast wall sections shall be of such lengths as will permit the setting of the manhole frame for the required elevation on two or three courses of brick masonry laid around the top of the upper section. Such brick work shall be given a 1-inch mortar coat on the inside and outside.

C. Precast items shall be installed in accordance with the manufacturer's recommendations, unless otherwise required by the Drawings.

3.03 MANHOLE LADDERS

A. The ladder shall be installed so bottom of ladder rests on or in the concrete shelf of the invert fill. The bottom step shall not interfere with piping. Angle brackets shall be spaced a maximum of 6 feet apart, with a minimum to two brackets per ladder section. The anchor bolts shall not be located within 12 inches of any joint in the manhole sections. Ladders shall be installed in conformance with the Drawings.

END OF SECTION

SECTION 03 60 00

GROUT

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. Furnish all materials, labor, and equipment required to provide all grout used in concrete work and as bearing surfaces for base plates, in accordance with the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Requirements of related work are included in Division 01 and Division 02 of these Specifications.

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.

1. CRD-C 621 – Corps of Engineers Specification for Non-shrink Grout

2. ASTM C 33 – Standard Specification for Concrete Aggregates

3. ASTM C 109 – Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2 inch or 50 mm cube Specimens)

4. ASTM C 531 – Standard Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts and Monolithic Surfacings

5. ASTM C 579 – Test Method for Compressive Strength of Chemical-Resistant Mortars and Monolithic Surfacings

6. ASTM C 827 – Standard Test Method for Early Volume Change of Cementitious Mixtures

7. ASTM C 1107 – Standard Specification for Packaged Dry, Hydraulic Cement Grout (Nonshrink)

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittal Procedures.

1. Certified test results verifying the compressive strength and shrinkage and expansion requirements specified herein.

2. Manufacturer's literature containing instructions and recommendations on the mixing, handling, placement, and appropriate uses for each type of grout used in the work.

1.05 QUALITY ASSURANCE

A. Field Tests

1. Compression test specimens will be taken during construction from the first placement of each type of grout and at intervals thereafter as selected by the Engineer to ensure continued compliance with these Specifications. The specimens will be made by the Engineer or its representative.

    a. Compression tests and fabrication of specimens for cement grout and non-shrink grout will be performed as specified in ASTM C 109 at intervals during construction as selected by the Engineer. A set of three specimens will be made for testing at seven days, 28 days, and any additional times as appropriate.

    b. Compression tests and fabrication of specimens for epoxy grout will be performed as specified in ASTM C 579, Method B, at intervals during construction as selected by the Engineer. A set of three specimens will be made for testing at seven days and any other time as appropriate.

2. The cost of all laboratory tests on grout will be borne by the Owner, but the Contractor shall assist the Engineer in obtaining specimens for testing. The Contractor shall be charged for the cost of any additional tests and investigation on work performed which does not meet the specifications. The Contractor shall supply all materials necessary for fabricating the test specimens, at no additional cost to the Owner.

3. All grout, already placed, which fails to meet the requirements of these Specifications, is subject to removal and replacement at no additional cost to the Owner.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Cement Grout

1. Cement grout shall be composed of Portland Cement and sand in the proportion specified in the Contract Documents and the minimum amount of water necessary

to obtain the desired consistency. If no proportion is indicated, cement grout shall consist of one-part Portland Cement to three parts sand. Water amount shall be as required to achieve desired consistency without compromising strength requirements. White Portland Cement shall be mixed with the Portland Cement as required to match color of adjacent concrete.

2. The minimum compressive strength at 28 days shall be 4000 psi.

3. For beds thicker than 1-1/2 inch and/or where free passage of grout will not be obstructed by coarse aggregate, 1-1/2 parts of coarse aggregate having a top size of 3/8 inch should be added. This stipulation does not apply for grout being swept in by a mechanism. These applications shall use a plain cement grout without coarse aggregate regardless of bed thickness. Cement grout used for surfaces swept in by a mechanism shall also contain micro-synthetic fibers in accordance with Section 03 30 00.

4. Sand shall conform to the requirements of ASTM C33.

B. Non-Shrink Grout

1. Non-shrink grout shall conform to CRD-C 621 and ASTM C 1107, Grade B or C when tested at a max. fluid consistency of 30 seconds per CDC 611/ASTM C939 at temperature extremes of 45°F and 90°F and an extended working time of 15 minutes. Grout shall have a min. 28-day strength of 7,000 psi. Non-shrink grout shall be, "NS Grout" by the Euclid Chemical Company, "Sikagrout 212" by Sika Corporation, “Conspec 100 Non-Shrink Non-Metallic Grout” by Conspec, “MasterFlow 928” by Master Builders Solutions.

C. Epoxy Grout

1. Epoxy grout shall be "Sikadur 32 Hi-Mod" by Sika Corporation, "Duralcrete LV" by Tamms Industries, or "E3 Series" by Euclid Chemical, “MasterEmaco ADH 1090 RS” by Master Builders Solutions.

2. Epoxy grout shall be modified as required for each application with aggregate per manufacturer's instructions.

D. Epoxy Base Plate Grout

1. Epoxy base plate grout shall be “Sikadur 42, Grout-Pak” by Sika Corporation, or “MasterFlow 648” by Master Builders Solutions.

2.02 CURING MATERIALS

A. Curing materials shall be as specified in Section 03 39 00 – Concrete Curing for cement grout and as recommended by the manufacturer for prepackaged grouts.

PART 3 – EXECUTION

3.01 GENERAL

A. The different types of grout shall be used for the applications stated below unless noted otherwise in the Contract Documents. Where grout is called for in the Contract Documents which does not fall under any of the applications stated below, non-shrink grout shall be used unless another type is specifically referenced.

1. Cement grout shall be used for grout toppings and for patching of fresh concrete, when approved by the Engineer. Grout toppings swept in by equipment mechanisms shall contain micro-synthetic fibers as specified in Section 03 30 00.

2. Non-shrink grout shall be used for grouting beneath base plates of structural metal framing.

3. Epoxy grout shall be used for bonding new concrete to hardened concrete.

4. Epoxy base plate grout shall be used for precision seating of base plates including base plates for all equipment such as engines, mixers, pumps, vibratory and heavy impact machinery, etc.

B. New concrete surfaces to receive cement grout shall be as specified in Section 03 35 00 – Concrete Finishes, and shall be cleaned of all dirt, grease, and oil-like films. Existing concrete surfaces shall likewise be cleaned of all similar contamination and debris, including chipping, or roughening the surface if a laitance or poor concrete is evident. The finish of the grout surface shall match that of the adjacent concrete. Curing and protection of cement grout shall be as specified in Section 03 39 00 – Concrete Curing.

C. All mixing, surface preparation, handling, placing, consolidation, and other means of execution for prepackaged grouts shall be done according to the instructions and recommendations of the manufacturer.

D. The Contractor, through the manufacturer of a non-shrink grout and epoxy grout, shall provide on-site technical assistance upon request, at no additional cost to the Owner.

3.02 CONSISTENCY

A. The consistency of grouts shall be that necessary to completely fill the space to be grouted for the application. Dry pack consistency is such that the grout is plastic and moldable but will not flow.

3.03 MEASUREMENT OF INGREDIENTS

A. Measurements for cement grout shall be made accurately by volume using containers. Shovel measurement shall not be allowed.

B. Prepackaged grouts shall have ingredients measured by means recommended by the manufacturer.

3.04 GROUT INSTALLATION

A. Grout shall be placed quickly and continuously, shall completely fill the space to be grouted and be thoroughly compacted and free of air pockets. The grout may be poured in place, pressure grouted by gravity, or pumped. The use of pneumatic pressure or dry-packed grouting requires approval of the Engineer. For grouting beneath base plates, grout shall be placed from one side only and allowed to flow across to the open side to avoid air-entrapment.

END OF SECTION

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DIVISION 05 – METALS

SECTION 05 05 13
GALVANIZING

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. Where galvanizing is called for in the Contract Documents, the galvanizing shall be performed in accordance with the provisions of this Section unless otherwise noted.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Further requirements for galvanizing specific items may be included in other Sections of the Specifications. See section for the specific item in question.

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.

1. Florida Building Code

2. ASTM A123 – Standard Specification for Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars, and Strip

3. ASTM A153 – Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

4. ASTM A653 – Standard Specification for Steel Sheet, Zinc Coated (Galvanized), or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

5. ASTM A924 – Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process

6. ASTM A780 – Standard Practice of Repair of Damaged Hot-Dip Galvanized Coatings

7. ASTM F2329 – Standard Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittal Procedures.

1. Certification that the item(s) are galvanized in accordance with the applicable ASTM standards specified herein. This certification may be included as part of any material certification that may be required by other Sections of the Specifications.

PART 2 – PRODUCTS

2.01 GALVANIC COATING

A. Material composition of the galvanic coating shall be in accordance with the applicable ASTM standards specified herein.

PART 3 – EXECUTION

3.01 FABRICATED PRODUCTS

A. Products fabricated from rolled, pressed, and forged steel shapes, plates, bars, and strips, 1/8 inch thick and heavier which are to be galvanized shall be galvanized in accordance with ASTM A123. Products shall be fabricated into the largest unit which is practicable to galvanize before the galvanizing is done. Fabrication shall include all operations necessary to complete the unit such as shearing, cutting, punching, forming, drilling, milling, bending, and welding. Components of bolted or riveted assemblies shall be galvanized separately before assembly. When it is necessary to straighten any sections after galvanizing, such work shall be performed without damage to the zinc coating. The galvanizer shall be a member of American Galvanizers Association.

B. Components with partial surface finishes shall be commercial blast cleaned prior to pickling.

C. Sampling and testing of each lot shall be performed prior to shipment from the galvanizer's facility per ASTM A123.

3.02 HARDWARE

A. Iron and steel hardware which is to be galvanized shall be galvanized in accordance with ASTM A153 and ASTM F2329.

3.03 ASSEMBLED PRODUCTS

A. Assembled steel products which are to be galvanized shall be galvanized in accordance with ASTM A123. All edges of tightly contacting surfaces shall be completely sealed by welding before galvanizing.

B. Assemblies shall be provided with vent and drain holes as required by the fabricator. Vent and drain hole sizes and locations shall be included in the structural steel shop drawings required in Section 05 12 00 – Structural Steel for approval. All vent and drain holes shall be plugged and finished to be flush with and blend in with the surrounding surface. Where water intrusion can occur, the plug shall be carefully melted into the surrounding zinc coating using an appropriate fluxing agent.

3.04 METAL DECK

A. Unless noted otherwise, metal deck shall be galvanized in accordance with ASTM A653 G60 minimum. In moist environments or as indicated on the Contract Drawings, galvanizing shall meet the requirements of ASTM A653 G90.

B. Galvanized metal deck shall meet the requirements of ASTM A924.

3.05 REPAIR OF GALVANIZING

A. Galvanized surfaces that are abraded or damaged at any time after the application of zinc coating shall be repaired by thoroughly wire brushing the damaged areas and removing all loose and cracked coating, after which the cleaned areas shall be painted with 2 coats of zinc rich paint meeting the requirements of Federal Specification DOD-P-21035A and shall be thoroughly mixed prior to application. Zinc rich paint shall not be tinted. The total thickness of the 2 coats shall not be less than 6 mils. In lieu of repairing by painting with zinc rich paint, other methods of repairing galvanized surfaces in accordance with ASTM A780 may be used provided the proposed method is acceptable to the Engineer.

END OF SECTION

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SECTION 05 05 23
METAL FASTENING

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. Furnish all materials, labor, and equipment required to provide all metal welds and fasteners not otherwise specified, in accordance with the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 05 10 00 – Metal Materials

B. Section 05 05 13 – Galvanizing

C. Section 05 12 00 – Structural Steel

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.

1. Florida Building Code
2. AC 193 – Acceptance Criteria for Mechanical Anchors in Concrete Elements
3. AC 308 – Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements
4. ACI 318 – Building Code Requirements for Structural Concrete
5. ACI 355.2 – Qualifications of Post-Installed Mechanical Anchors in Concrete
6. ACI 355.4 – Qualifications of Post-Installed Adhesive Anchors in Concrete
7. AISC – RCSC Specification for Structural Joints Using High Strength Bolts
8. AISC – Code of Standard Practice
9. AWS D1.1 – Structural Welding Code – Steel
10. AWS D1.2 – Structural Welding Code – Aluminum

11. AWS D1.6 – Structural Welding Code – Stainless Steel

12. Aluminum Association – Specifications for Aluminum Structures

13. ASTM A572/A572M-94C – Standard Specification for High Strength Low-Alloy Columbium-Vanadium Structural Steel Grade 50

14. ASTM A36 – Standard Specification for Carbon Structural Steel

15. ASTM A489 – Standard Specification for Eyebolts

16. ASTM A563 – Standard Specifications for Carbon and Alloy Steel Nuts

17. ASTM D1785 – Standard Specification for Polyvinyl Chloride (PVC) Plastic Pipe

18. ASTM E3121 – Standard Test Methods for Field Testing of Anchors in Concrete or Masonry

19. ASTM F436 – Standard Specification for Hardened Steel Washers

20. ASTM F467 – Standard Specification for Nonferrous Nuts for General Use

21. ASTM F593 – Standard Specification for Stainless Steel Bolts; Hex Cap Screws, and Studs

22. ASTM F594 – Standard Specification for Stainless Steel Nuts

23. ASTM F1554 – Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength

24. ASTM F3125 – Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi and 150 ksi Minimum Tensile Strength, Inch and Metric Dimension

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittal Procedures.

1. Shop Drawings providing the fastener's manufacturer and type and certification of the fastener's material and capacity.

2. Anchor design calculations sealed by a Professional Engineer currently registered in the State of Florida. Only required if design not shown on Contract Drawings.

3. A current Evaluation Report shall be submitted for all anchors that will be considered for use on this project.

4. Manufacturer’s installation instructions.

5. Copy of valid certification for each person who is to perform field welding.

6. Certified weld inspection reports, when required.

7. Welding procedures.

8. Installer qualifications.

9. Certification of Installer Training.

10. Inspection Reports.

11. Results of Anchor Proof Testing.

12. For outdoor equipment, anchorage calculations to resist wind loads, signed and sealed by a Professional Engineer registered in the State of Florida.

13. Manufacturer's Literature for Resistance of Adhesive to Appropriate Chemical Exposure, where deemed necessary.

1.05 QUALITY ASSURANCE

A. Fasteners not manufactured in the United States shall be tested and certification provided with respect to specified quality and strength standards. Certifications of origin shall be submitted for all U.S. fasteners supplied on the project.

B. Evaluation Report: A current Evaluation Report from an independent testing and evaluation agency (ITEA) shall be submitted for all anchors that will be used on this project. The ITEA producing the evaluation report shall be accredited in accordance with the requirements for ITEA's in ACI 355.2 (for mechanical anchors) or 355.4 (for adhesive anchors). Acceptable ITEA's include but are not necessarily limited to the International Code Council Evaluation Service (ICC-ES) and the International Association of Plumbing and Mechanical Officials Uniform Evaluation Service (IAPMO-UES).

C. Installer Qualifications: All concrete anchors shall be installed by an Installer with at least three years of experience performing similar installations. Concrete adhesive anchor installers for anchor installations in horizontal to vertically overhead applications shall be certified as an Adhesive Anchor Installer in accordance with ACI-CRSI Adhesive Anchor Installation Certification Program.

D. Installer Training: For concrete anchors, conduct a thorough training with the manufacturer or the manufacturer's representative for the Installer on the project. Training shall consist of a review of the complete installation process to include but not be limited to the following:

1. Hole drilling procedure.

2. Hole preparation and cleaning technique.

3. Adhesive injection technique and dispenser training/maintenance.

4. Concrete adhesive anchor preparation and installation.

5. Proof loading/torquing.

6. Provide a list of names of all installers who are trained by the Manufacturer's Field Representative on this jobsite prior to installation of products. Record must include the installer name, date of training, products included in the training and trainer name and contact information.

7. Provide a copy of the current ACI/CRSI "Adhesive Anchor Installer" certification cards for all installers who will be installing adhesive anchors in the horizontal to vertically overhead orientation.

E. All steel welding shall be performed by welders certified in accordance with AWS D1.1. All aluminum welding shall be performed by welders certified in accordance with AWS D1.2. All stainless-steel welding shall be performed by welders certified in accordance with AWS D1.6. Certifications of field welders shall be submitted prior to performing any field welds.

F. Welds and high strength bolts used in connections of structural steel will be visually inspected in accordance with Article 3.04.

G. The Owner may engage an independent testing agency to perform testing of welded connections and to prepare test reports in accordance with AWS. Inadequate welds shall be corrected or redone and retested to the satisfaction of the Engineer and/or an acceptable independent testing laboratory, at no additional cost to the Owner.

H. Provide a welding procedure for each type and thickness of weld. For welds that are not prequalified, include a Performance Qualification Report. The welding procedure shall be given to each welder performing the weld. The welding procedure shall follow the format in Annex E of AWS D1.1 with relevant information presented.

I. Inspections of the adhesive dowel system shall be made by the Engineer or other representatives of the Owner in accordance with the requirements of the ESR published by the manufacturer. Provide adequate time and access for inspections of products and anchor holes prior to injections, installation, and proof testing.

PART 2 – PRODUCTS

2.01 ANCHOR RODS

A. Anchor rods shall conform to ASTM F1554 Grade 55 except where stainless steel or other approved anchor rods are shown on the Drawings or stated herein. Anchor rods shall have

hexagonal heads and shall be supplied with hexagonal nuts meeting the requirements of ASTM A563 Grade A. Washers shall meet the requirements of ASTM A436.

B. All anchors into concrete shall be cast-in-place anchors unless specifically referenced otherwise on Drawings.

C. Where anchor rods are used to anchor galvanized steel or are otherwise specified to be galvanized, anchor rods and nuts shall be hot dipped galvanized in accordance with ASTM F1554.

D. Where pipe sleeves around anchor rods are shown on the Drawings, pipe sleeves shall be cut from Schedule 40 PVC plastic piping meeting the requirements of ASTM D1785.

2.02 HIGH STRENGTH BOLTS

A. High strength bolts and associated nuts and washers shall be in accordance with ASTM F3125, Grade A325 Type 1 or Grade F1852 Type 1. Bolts, nuts, and washers shall meet the requirements of RCSC “Specification for Structural Joints Using High Strength Bolts”.

B. Where high strength bolts are used to connect galvanized steel or are otherwise specified to be galvanized, bolts, nuts, and washers shall be hot dipped galvanized in accordance with ASTM A325.

2.03 STAINLESS STEEL BOLTS

A. Stainless steel bolts shall conform to ASTM F-593 for alloy groups 1 and 2, Condition CW1, or ASTM F-3125. All underwater fasteners, fasteners in confined areas containing fluid, and fasteners in corrosive environments shall be Type 316 stainless steel unless noted otherwise. Fasteners for aluminum and stainless-steel members not subject to the above conditions shall be Type 304 stainless steel unless otherwise noted.

B. Stainless steel bolts shall have hexagonal heads with a raised letter or symbol on the bolts indicating the manufacturer and shall be supplied with hexagonal nuts meeting the requirements of ASTM F594. Nuts, washers, and lock washers shall be of the same alloy as the bolts.

2.04 CONCRETE ANCHORS

A. General

1. Where concrete anchors are called for on the Drawings, one of the types listed below shall be used; except, where one of the types listed below is specifically called for on the Drawings, only that type shall be used. If no specific type is indicated on the Drawings, the concrete anchor shall be a cast-in-place anchor. The determination of anchors equivalent to those listed below shall be based on test data performed by an approved independent testing laboratory. Two types of anchors shall be used:

a. Mechanical anchors include any of the following anchors:

1) Expansion anchors shall be mechanical anchors of the wedge, sleeve, or drop-in type that are set by expanding against the sides of the drilled hole.

2) Screw anchors are mechanical anchors that derive tensile holding strength by the mechanical interlock provided by threads cutting into the concrete during installation. Screw anchors shall be one-piece, heavy duty screw anchors with a finished head.

b. Adhesive anchors shall consist of threaded rods or bolts anchored with an adhesive system into hardened concrete. Adhesive anchors shall be two-part injection type using the manufacturer's static mixing nozzle and shall be supplied as an entire system.

2. Adhesive anchors shall conform to the requirements of ACI 355.4 or alternately to AC 308. Mechanical anchors shall conform to the requirements of ACI 355.2 or alternately to AC 193.

3. Fire Resistance: All anchors installed within fire resistant construction shall either be enclosed in a fire-resistant envelope, be protected by approved fire-resistive materials, be used to resist wind and earthquake loads only, or anchor non-structural elements.

4. Engineer's approval is required for use of concrete anchors in locations other than those shown on the Drawings.

B. Wedge Anchors:

1. Do not use when subjected to vibration.

2. Do not use in exterior locations or locations subjected to freezing.

3. Do not use in submerged, intermittently submerged, or buried locations.

4. Suitable for use in overhead applications.

C. Screw Anchors:

1. Do not use when subjected to vibration.

2. Do not use in exterior locations or locations subjected to freezing.

3. Do not use in submerged, intermittently submerged, or buried locations.

4. Do not use in overhead applications.

D. Sleeve Anchors:

1. Do not use when subjected to vibration.

2. Do not use in exterior locations or locations subjected to freezing.

3. Do not use in submerged, intermittently submerged, or buried locations.

4. Suitable for use in overhead applications.

E. Undercut Anchors:

1. Suitable for use where subjected to vibration.

2. Do not use in exterior locations or locations subjected to freezing.

3. Do not use in submerged, intermittently submerged, or buried locations.

4. Suitable for use in overhead applications.

F. Adhesive Anchors in Concrete:

1. Suitable for use where subjected to vibration.

2. Suitable for use in exterior locations or locations subjected to freezing.

3. Suitable for use in submerged, intermittently submerged, or buried locations.

4. Do not use in overhead applications, unless otherwise shown or approved by Engineer.

5. Suitable for use in chemical areas provided manufacturer's literature confirms appropriate chemical resistance.

6. Do not use for pipe hangers, unless otherwise shown or approved by Engineer.

G. Adhesive Anchors in Masonry

1. Suitable for use where subjected to vibration.

2. Suitable for use in exterior locations or locations subjected to freezing.

3. Do not use for pipe hangers, unless otherwise shown or approved by Engineer.

4. Suitable for use in precast hollow core planks.

H. Concrete Anchor Design:

1. Basis of design shall include the following design parameters:

    a. Actual compressive strength of concrete.

    b. Cracked concrete conditions.

    c. Dry or water saturated installation conditions.

    d. Base material temperature between 40- and 104-degrees Fahrenheit.

    e. Installation with hammer drill or hollow-drill bit system drilling methods.

    f. Installation not prior to 21-day minimum age of concrete.

2. An anchor design consists of specifying anchor size, quantity, spacing, edge distance and embedment to resist all applicable loads. Where an anchor design is indicated on the Drawings, the anchors shall be installed to the prescribed size, spacing, embedment depth, and edge distance. If all parts of an anchor design are provided on the Drawings except embedment depth, the Contractor shall provide the embedment depth as indicated in Paragraph B.3 unless otherwise directed by the Engineer. Where an anchor design is not indicated on the Drawings, the Contractor shall provide the anchor design per the requirements listed below.

    a. The Contractor shall submit design with signed and sealed calculations and drawings performed by an Engineer currently registered in the State or Commonwealth in which the project is located. Anchors shall be of a type recommended by the anchor manufacturer for use in cracked concrete and shall be designed by the Contractor in accordance with ACI 318 CHAPTER 17)

    b. Embedment Depth

        1) Minimum anchor embedment shall be as indicated on the Drawings unless anchor design is stipulated to be by Contractor or equipment provider. The provider of equipment including pumps, blowers, etc. shall provide anchor design including size of anchors, pattern, and embedment depth. If the equipment provider is unable to provide design of embedment depth, the design shall be provided by the contractor using the loads furnished by the equipment provider. Although all manufacturers listed are permitted, the embedment depth indicated on the Drawings is based on “Pure 110+ by DeWalt”. If the contractor submits one of the other concrete adhesive anchors listed, the Engineer shall evaluate the required embedment, and the Contractor shall provide the required embedment depth stipulated by the Engineer specific to the approved dowel adhesive.

2) Where the embedment depth is not shown on the Drawings, concrete anchors shall be embedded no less than the manufacturer's standard embedment (expansion or mechanical anchors) or to provide a minimum allowable bond strength equal to the allowable yield capacity of the rod according to the manufacturer (adhesive anchors).

3) The embedment depth shall be determined using the actual concrete compressive strength, a cracked concrete state, maximum long-term temperature of 110 degrees F, and maximum short-term temperature of 140 degrees F. In no case shall the embedment depth be less than the minimum or more than the maximum stated in the manufacturer's literature.

I. Anchors:

1. Mechanical Anchors:

a. Wedge Anchors: Wedge anchors shall be "Kwik Bolt TZ" by Hilti, Inc., "Strong-Bolt 2" by Simpson Strong-Tie Co. or "Power-Stud+SD1" or "Power-Stud+ SD-2" by DeWalt.

b. Screw Anchors: Screw anchors shall be "KWIK HUS-EZ", "KWIK HUS-EZ-I", or "KWIK HUS-EZ CRC" by Hilti, Inc., "Titen HD" or "Stainless Steel Titen HD" by Simpson Strong-Tie Co., or "Screw-Bolt+" by DeWalt.

c. Sleeve Anchors: Sleeve anchors shall be "HSL-3 Heavy Duty Sleeve Anchor" by Hilti, Inc. or "Power-Bolt +" by DeWalt.

d. Shallow Embedment Internally Threaded Insert (3/4" max embedment): "Mini-Undercut +Anchor" by DeWalt, "HDI-P-TZ" by Hilti, Inc. or approved equal.

e. Concrete Undercut Anchors: Concrete undercut anchors shall be "HDA Undercut Anchors" by Hilti, Inc, "DUC Ductile Undercut Anchor", by USP Structural Connectors, or approved equal.

f. Mechanical anchor systems shall comply with ACI 355.2 or alternatively the latest revision of AC 193 and shall have a valid evaluation report in accordance with the applicable building code.

2. Adhesive Anchors:

a. Adhesive anchors shall be "HIT HY-200 Adhesive Anchoring System" by Hilti, Inc., "SET-3G Epoxy Adhesive Anchors" by Simpson Strong-Tie Co., or "Pure 110+ Epoxy Adhesive Anchor System" by DeWalt.

b. Adhesive anchor systems shall be IBC compliant and capable of resisting short term wind and seismic loads (Seismic Design Categories A through F)

as well as long term and short term sustained static loads in both cracked and uncracked concrete in all Seismic Design Categories. Adhesive anchor systems shall comply with ACI 355.4 or alternatively the latest revision of AC308 and shall have a valid evaluation report in accordance with the applicable building code. **No or equal products will be considered unless prequalified and approved by the Engineer and Owner**.

J. Concrete Anchor Materials:

1. Concrete anchors used to anchor structural steel shall be a threaded steel rod per manufacturer's recommendations for proposed adhesive system but shall not have a yield strength (fy) less than 58 ksi nor an ultimate strength (fu) less than 72.5 ksi, unless noted otherwise. Where steel to be anchored is galvanized, concrete anchors shall also be galvanized unless otherwise indicated on the Drawings.

2. Concrete anchors used to anchor aluminum, FRP, or stainless steel shall be manufactured from stainless steel unless noted otherwise. All underwater fasteners, fasteners in confined areas containing fluid, and fasteners in corrosive environments shall be Type 316 stainless steel unless noted otherwise. Fasteners for aluminum and stainless-steel members not subject to the above conditions shall be Type 304 stainless steel unless otherwise noted.

3. Nuts, washers, lock washers and other hardware shall be of a material to match the anchors.

2.05 MASONRY ANCHORS

A. Anchors for fastening to solid or grout-filled masonry shall be adhesive anchors consisting of threaded rods or bolts anchored with an adhesive system. The adhesive system shall be "HIT HY-270 System" as manufactured by Hilti, Inc., "AC100+ Acrylic Adhesive" by DeWalt, or "SET-XP" as manufactured by Simpson Strong-Tie Co.

B. Anchors for fastening to hollow masonry or brick shall be adhesive anchors consisting of threaded rods or bolts anchored with an adhesive system dispensed into a screen tube inserted into the masonry. The adhesive system shall use a two-component adhesive mix and shall inject into the screen tube with a static mixing nozzle. Thoroughly clean drill holes of all debris and drill dust prior to installation of adhesive and anchor. Contractor shall follow manufacturer's installation instructions. The adhesive system shall be "HIT HY-270 System" as manufactured by Hilti, Inc., "AC100+ Acrylic Adhesive" by DeWalt, or "SET-XP" as manufactured by Simpson Strong-Tie Co.

C. Masonry anchors used to anchor steel shall be a threaded steel rod per manufacturer's recommendations for proposed adhesive system but shall not have a yield strength (fy) less than 58 ksi nor an ultimate strength (fu) less than 72.5 ksi, unless noted otherwise. Where steel to be anchored is galvanized, masonry anchors shall also be galvanized.

D. Masonry anchors used to anchor aluminum, FRP, or stainless steel shall be manufactured from stainless steel unless noted otherwise. All underwater fasteners, fasteners in confined areas containing fluid, and fasteners in corrosive environments shall be Type 316 stainless steel unless noted otherwise. Fasteners for aluminum and stainless-steel members not subject to the above conditions shall be Type 304 stainless steel unless otherwise noted.

E. Nuts, washers, lock washers and other hardware shall be of a material to match the anchors.

F. Although all manufacturers listed are permitted, the masonry anchor design is based on “SET-XP by Simpson Strong-Tie. If the contractor submits one of the other concrete adhesive anchors listed, the Engineer shall evaluate the proposed product and the Contractor shall provide the conditions stipulated by the Engineer specific to the approved adhesive anchor.

2.06 WELDS

A. Electrodes for welding structural steel and all ferrous steel shall comply with AWS Code, using E70 series electrodes for shielded metal arc welding (SMAW), or F7 series electrodes for submerged arc welding (SAW).

B. Electrodes for welding aluminum shall comply with the Aluminum Association Specifications and AWS D1.2.

C. Electrodes for welding stainless steel and other metals shall comply with AWS D1.6.

2.07 WELDED STUD CONNECTORS

A. Welded stud connectors shall conform to the requirements of AWS D1.1 Type C.

2.08 EYEBOLTS

A. Eyebolts shall conform to ASTM A489 unless noted otherwise.

2.09 HASTELLOY FASTENERS

A. Hastelloy fasteners and nuts shall be constructed of Hastelloy C-276. Hastelloy fasteners shall be used for fasteners located in chemical areas containing Hydrochloric Acid (Muriatic Acid), Hydrofluosilicic Acid (Fluoride), or Sulfuric Acid.

2.10 TITANIUM FASTENERS

A. Titanium fasteners, washers, and nuts shall conform to ASTM B348, Grade 2. Titanium fasteners shall be used for fasteners located in chemical areas containing Ferric Chloride or Sodium Hypochlorite.

2.11 ANTISEIZE LUBRICANT

A. Antiseize lubricant shall be C5-A Anti-Seize by Loctite Corporation, Molykote P-37 Anti-Seize Paste by Dow Corning, 3M Anti-Seize by 3M, or equal.

PART 3 – EXECUTION

3.01 MEASUREMENTS

A. The Contractor shall verify all dimensions and review the Drawings and shall report any discrepancies to the Engineer for clarification prior to starting fabrication.

3.02 FASTENER INSTALLATION

A. Anchor Rods, Concrete Anchors, and Masonry Anchors

1. Anchor rods shall be installed in accordance with AISC "Code of Standard Practice" by setting in concrete while it is being placed and positioned by means of a rigidly held template. Overhead adhesive anchors, and base plates or elements they are anchoring, shall be shored as required and securely held in place during anchor setting to prevent movement during anchor installation. Movement of anchors during curing is prohibited.

2. The Contractor shall verify that all concrete and masonry anchors have been installed in accordance with the manufacturer's recommendations and that the capacity of the installed anchor meets or exceeds the specified safe holding capacity.

3. Concrete anchors shall not be used in place of anchor rods without Engineer's approval.

4. All stainless-steel threads shall be coated with anti-seize lubricant.

B. High Strength Bolts

1. All bolted connections for structural steel shall use high strength bolts. High strength bolts shall be installed in accordance with RCSC “Specification for Structural Joints Using High Strength Bolts”. All bolted joints shall be Type N, snug-tight, bearing connections in accordance with AISC Specifications unless noted otherwise on the Drawings.

C. Stainless Steel Bolts

1. Where connections indicate the use of stainless-steel bolts, the bolts shall be installed to the snug tight condition. Connections shall include stainless steel

washers under both the bolt head and the nut head. Lock washers shall be utilized for all connections and shall be placed under the nut head.

D. Concrete Anchors

1. Concrete at time of anchor installation shall be a minimum age of 21 days, have a minimum compressive strength of 2500 psi, and ambient temperature at time of installation shall be at least 50 degrees F.

2. Concrete Anchor Testing:

a. At all locations, at least 5 percent of all concrete anchors installed shall be proof tested to 80% of the yield strength of the anchor rod, with a minimum of one tested anchor per anchor group.

b. Contractor shall submit a plan and schedule indicating locations of anchors to be proof tested, load test values and proposed anchor testing procedure (including a diagram of the testing equipment proposed for use) to the Engineer for review prior to conducting any testing. Proof testing of anchors shall be in accordance with ASTM E3121 for the static tension test. If additional tests are required, inclusion of these tests shall be as stipulated on Contract Drawings.

c. Where Contract Documents indicate anchor design to be the Contractor's responsibility, the Contractor shall submit a plan and schedule indicating locations of anchors to be proof tested and load test values, sealed by a Professional Engineer currently registered in the State or Commonwealth in which the project is located. Documentation shall also be submitted indicating the Contractor's proof testing procedures have been reviewed and the proposed procedures are acceptable. Proof testing procedures shall be in accordance with ASTM E3121.

d. Concrete Anchors shall have no visible indications of displacement or damage during or after the proof test. Concrete cracking in the vicinity of the anchor after loading shall be considered a failure. Anchors exhibiting damage shall be removed and replaced. If more than 5 percent of tested anchors fail, then 100 percent of anchors shall be proof tested.

e. Proof testing of concrete anchors shall be performed by an independent testing laboratory hired directly by the Contractor and approved by the Engineer. The Contractor shall be responsible for costs of all proof testing, including additional testing required due to previously failed tests.

3. All concrete anchors shall be installed in strict conformance with the manufacturer's printed installation instructions. A representative of the manufacturer shall be on site when required by the Engineer.

4. All holes shall be drilled in accordance with the manufacturer's instructions except that cored holes shall not be allowed unless specifically approved by the Engineer. If cored holes are allowed, cored holes shall be roughened in accordance with manufacturer requirements. Thoroughly clean drill holes of all debris, drill dust, and water in accordance with the manufacturer's instructions prior to installation of adhesive and threaded rod unless otherwise recommended by the manufacturer. Degree of hole dampness shall be in strict accordance with manufacturer recommendations. Installation conditions shall be either dry or water saturated. Water filled or submerged holes shall not be permitted unless specifically approved by the Engineer. Injection of adhesive into the hole shall be performed to minimize the formation of air pockets in accordance with the manufacturer's instructions. Wipe rod free from oil that may be present from shipping or handling.

5. All adhesive anchor installations in the horizontal to vertically overhead orientation shall be conducted by a certified Adhesive Anchor Installer as certified by ACI/CSRI per ACI 318-14 17.8.2.2. Current AAI Certificate must be submitted to the Engineer of Record prior to commencement of any adhesive anchor installations.

E. Other Bolts

1. All dissimilar metal shall be connected with appropriate fasteners and shall be isolated via an approved dielectric.

2. All stainless-steel bolts shall be coated with anti-seize lubricant.

3.03 WELDING

A. All welding shall comply with AWS Code for procedures, appearance, quality of welds, qualifications of welders and methods used in correcting welded work.

B. Welded stud connectors shall be installed in accordance with AWS D1.1.

C. Welds shown on the Drawings with a field weld symbol shall be field welded. All other welds shall be shop welded unless specifically approved by the Engineer.

3.04 INSPECTION

A. High strength bolting will be visually inspected in accordance with RCSC "Specification for Structural Joints Using High Strength Bolts". Rejected bolts shall be either replaced or retightened as required.

B. Field welds will be visually inspected in accordance with AWS Codes. Inadequate welds shall be corrected or redone as required in accordance with AWS Codes.

C. Post-installed concrete anchors shall be inspected as required by ACI 318.

3.05 CUTTING OF EMBEDDED REBAR

A. The Contractor shall not cut embedded rebar cast into structural concrete during installation of post-installed fasteners without prior approval of the Engineer.

END OF SECTION

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SECTION 05 10 00
METAL MATERIALS

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. Metal materials not otherwise specified shall conform to the requirements of this Section.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Materials for fasteners are included in Section 05 05 23 – Metal Fastening.

B. Requirements for specific products made from the materials specified herein are included in other sections of the Specifications. See the section for the specific item in question.

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. ASTM A36 – Standard Specification for Structural Steel

B. ASTM A47 – Standard Specification for Malleable Iron Castings

C. ASTM A48 – Standard Specification for Gray Iron Castings

D. ASTM A53 – Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless

E. ASTM A167 – Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip

F. ASTM A276 – Standard Specification for Stainless and Heat-Resisting Steel Bars and Shapes

G. ASTM A307 – Standard Specification for Carbon Steel Externally Threaded Standard Fasteners

H. ASTM A446 – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Structural (Physical) quality

I. ASTM A500 – Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes

J. ASTM A501 – Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing

K. ASTM A529 – Standard Specification for Structural Steel with 42 000 psi (290 Mpa) Minimum Yield Point (1/2 in. (12.7 mm) Maximum Thickness)

L. ASTM A536 – Standard Specification for Ductile Iron Castings

M. ASTM A570 – Standard Specification for Hot-Rolled Carbon Steel Sheet and Strip, Structural Quality

N. ASTM A572 – Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel

O. ASTM A992 – Standard Specification for Structural Steel Shapes

P. ASTM A666 – Standard Specification for Austenitic Stainless Steel, Sheet, Strip, Plate, and Flat Bar for Structural Applications

Q. ASTM A1085 – Standard Specification for Cold-Formed Welded Carbon Steel Hollow Structural Sections (HSS)

R. ASTM B26 – Standard Specification for Aluminum-Alloy Sand Castings

S. ASTM B85 – Standard Specification for Aluminum-Alloy Die Castings

T. ASTM B108 – Standard Specification for Aluminum-Alloy Permanent Mold Castings

U. ASTM B138 – Standard Specification for Manganese Bronze Rod, Bar, and Shapes

V. ASTM B209 – Standard Specification for Aluminum-Alloy Sheet and Plate

W. ASTM B221 – Standard Specification for Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes

X. ASTM B308 – Standard Specification for Aluminum-Alloy Standard Structural Shapes, Rolled or Extruded

Y. ASTM B574 – Standard Specification for Nickel-Molybdenum-Chromium Alloy Rod

Z. ASTM F468 - Standard Specification for Nonferrous Bolts, Hex Cap Screws, and Studs for General Use

AA. ASTM F593 – Standard Specification for Stainless Steel Fasteners

1.04 SUBMITTALS

A. Material certifications shall be submitted along with any shop drawings for metal products and fabrications required by other sections of the Specifications.

1.05 QUALITY ASSURANCE

A. Owner may engage the services of a testing agency to test any metal materials for conformance with the material requirements herein. If the material is found to be in conformance with Specifications the cost of testing will be borne by the Owner. If the material does not conform to the Specifications, the cost of testing shall be paid by the Contractor and all materials not in conformance as determined by the Engineer shall be replaced by the Contractor at no additional cost to the Owner. In lieu of replacing materials, the Contractor may request further testing to determine conformance, but any such testing shall be paid for by the Contractor regardless of outcome of such testing.

PART 2 – PRODUCTS

2.01 CARBON AND LOW ALLOY STEEL

A. Material types and ASTM designations shall be as listed below:

Steel W, C, and MC Shapes	A992
Steel HP Shapes	A572 Grade 50
Steel M and S shapes and Angles, Bars, and Plates	A36
Rods	F 1554 Grade 36
Pipe - Structural Use	A53 Grade B
Hollow Structural Sections	A500 Grade C or A1085 Grade A
Cold-Formed Steel Framing	A 653

2.02 STAINLESS STEEL

A. All stainless steel fabrications exposed to underwater service shall be Type 316. All other stainless steel fabrications shall be Type 304, unless noted otherwise.

B. Material types and ASTM designations are listed below:

Plates and Sheets	ASTM A167 or A666 Grade A
Structural Shapes	ASTM A276
Fasteners (Bolts, etc.)	ASTM F593

2.03 ALUMINUM

A. All aluminum shall be alloy 6061-T6, unless otherwise noted or specified herein.

B. Material types and ASTM designations are listed below:

Structural Shapes	ASTM B308
Castings	ASTM B26, B85, or B108
Extruded Bars	ASTM B221 - Alloy 6061
Extruded Rods, Shapes and Tubes	ASTM B221 - Alloy 6063
Plates	ASTM B209 - Alloy 6061
Sheets	ASTM B221 - Alloy 3003

C. All aluminum structural members shall conform to the requirements of Section 05 14 00 – Structural Aluminum.

D. All aluminum shall be provided with mill finish unless otherwise noted.

E. Where bolted connections are indicated, aluminum shall be fastened with stainless steel bolts.

2.04 CAST IRON

A. Material types and ASTM designations are listed below:

Gray	ASTM A48 Class 30B
Malleable	ASTM A47
Ductile	ASTM A536 Grade 60-40-18

2.05 BRONZE

A. Material types and ASTM designations are listed below:

Rods, Bars and Sheets	ASTM B138 - Alloy B Soft

2.06 HASTELLOY

A. All Hastelloy shall be Alloy C-276.

2.07 DISSIMILAR METALS

A. Dielectric isolation shall be installed wherever dissimilar metals are connected according to the following table.

	Zinc	Galvanized Steel	Aluminum	Cast Iron	Ductile Iron	Mild Steel/ Carbon Steel	Copper	Brass	Stainless Steel
Zinc			●	●	●	●	●	●	●
Galvanized Steel			●	●	●	●	●	●	●
Aluminum	●	●		●	●	●	●	●	●
Cast Iron	●	●	●				●	●	●
Ductile Iron	●	●	●				●	●	●
Mild Steel/ Carbon Steel	●	●	●				●	●	●
Copper	●	●	●	●	●	●			●
Brass	●	●	●	●	●	●			●
Stainless Steel	●	●	●	●	●	●	●	●	

1. "●" signifies dielectric isolation is required between the two materials noted.

2. *Consult Engineer for items not listed in table.*

PART 3 – EXECUTION (NOT USED)

END OF SECTION

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SECTION 05 12 00
STRUCTURAL STEEL

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. Furnish all equipment, labor, materials, and services required to provide all structural steel work in accordance with the Contract Documents. The term "structural steel" shall include items as defined in the AISC "Code of Standard Practice".

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 05 10 00 – Metal Materials

B. Section 05 05 13 – Galvanizing

C. Section 05 05 23 – Metal Fastening

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Without limiting the generality of the Specifications, all work specified herein shall conform to the applicable requirements of the following documents.

1. Florida Building Code

2. AISC – "Code of Standard Practice"

3. AISC – "Specification for Structural Steel Buildings"

4. AISC – RCSC “Specification for Structural Joints Using High Strength Bolts”

5. AWS – "Structural Welding Code"

6. ASTM A786 – Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittal Procedures.

1. Certified Mill Test Reports

2. Affidavit of Compliance with grade specified

3. Shop Drawings which include the following:

a. Layout drawings indicating all structural shapes, sizes, and dimensions.

b. Beam and column schedules.

c. Detailed drawings indicating jointing, anchoring and connection details and vent and drain holes where required.

4. Certified weld inspection reports.

5. No fabrication shall be started until shop drawings have been approved by the Engineer.

6. Where structural design of the steel is not indicated on the Drawings, the Contractor shall submit design drawings of the steel framing, connections and anchor bolts. Such drawings shall be signed and sealed by a Professional Engineer registered in the State of Florida.

1.05 QUALITY ASSURANCE

A. Shop inspection may be required by the Owner at the Owner's expense. The Contractor shall give ample notice to the Engineer prior to the beginning of any fabrication work so that inspection may be provided. The Contractor shall furnish all facilities for the inspection of materials and workmanship in the shop, and the inspectors shall be allowed free access to the necessary parts of the work. Inspectors shall have the authority to reject any materials or work which do not meet the requirements of these Specifications. Inspection at the shop is intended as a means of facilitating the work and avoiding errors, but is expressly understood that it will in no way relieve the Contractor from the responsibility for furnishing proper materials or workmanship under this Specification.

B. The Owner may engage inspectors to inspect welded connections and to perform tests and prepare test reports.

1. Ten percent of all butt and bevel welds which extend continuously for 24 inches or less will be completely tested in accordance with AWS D1.1, Part B, Radiographic Testing of Welds, Chapter 6. All butt and bevel welds which extend continuously for more than 24 inches will be spot tested at intervals not exceeding 36 inches.

2. Welds that are required by the Engineer to be corrected shall be corrected or redone and retested as directed, at the Contractor's expense, and to the satisfaction of the Engineer and/or an acceptable independent testing lab.

C. The structural steel erector shall be a qualified installer who participates in the AISC Certification program and is designated an AISC Certified Erector.

D. The structural steel fabricator shall be a qualified fabricator who participates in the AISC Certification program and is designated an AISC Certified Building Fabricator.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Structural Steel

1. Structural steel for W, C, and MC shapes shall conform to ASTM A992 unless otherwise indicated.

2. Structural steel for HP shapes shall conform to ASTM A572 Grade 50 unless otherwise indicated.

3. Structural steel for S and M shapes and angles and plates shall conform to ASTM A36 unless otherwise indicated.

4. Steel pipe shall be ASTM A53, Grade B.

5. HSS shall be ASTM A500, Grade C or ASTM A1085. All members shall be furnished full length without splices unless otherwise noted or accepted by the Engineer.

6. All unidentified steel will be rejected and shall be removed from the site and replaced by the Contractor, all at the expense of the Contractor.

7. Fasteners for structural steel shall be in accordance with Section 05 05 23 – Metal Fastening.

B. Welds

1. Electrodes for welding shall be in accordance with Section 05 05 23 – Metal Fastening.

PART 3 – EXECUTION

3.01 MEASUREMENT

A. The Contractor shall verify all dimensions and shall make any field measurements necessary and shall be fully responsible for accuracy and layout of work. The Contractor shall review the Drawings and any discrepancies shall be reported to the Engineer for clarification prior to starting fabrication.

3.02 FABRICATION

A. Fabrication shall be in accordance with the AISC "Specification for Structural Steel Buildings and AISC "Code of Standard Practice". Fabrication shall begin only after Shop Drawing approval.

B. Except where otherwise noted on the Drawings or in this Specification, all shop connections shall be welded.

C. All holes in structural steel members required for anchors, anchor rods, bolts, sag rods, vent and drain holes or other members or for attachment of other work shall be provided by the fabricator and detailed on the Shop Drawings.

D. All materials shall be properly worked and match-marked for field assembly.

E. Where galvanizing of structural steel is required, galvanizing shall be done in accordance with Section 05 05 13 – Galvanizing.

F. Checkered floor plate shall meet the requirements of ASTM A786.

3.03 DELIVERY, STORAGE AND HANDLING

A. Structural members shall be loaded in such a manner that they may be transported and unloaded without being over-stressed, deformed or otherwise damaged.

B. Structural steel members and packaged materials shall be protected from corrosion and deterioration. Material shall be stored in a dry area and shall not be placed in direct contact with the ground. Materials shall not be placed on the structure in a manner that might cause distortion or damage to the members or the supporting structures. The Contractor shall repair or replace damaged materials or structures as directed.

3.04 ERECTION

A. The erection of all structural steel shall conform to the applicable requirements of the AISC "Specification for Structural Steel Buildings" and AISC "Code of Standard Practice". All temporary bracing, guys and bolts as may be necessary to ensure the safety of the structure until the permanent connections have been made shall be provided by the Contractor.

B. Structural members shall be set accurately to the lines and elevations indicated. The various members shall be aligned and adjusted to form a part of a complete frame or structure before permanently fastened.

C. No cutting of structural steel members in the field will be allowed except by the written approval of the Engineer.

D. Bearing surfaces and other surfaces which will be in permanent contact shall be cleaned before assembly.

E. Field welding shall not be permitted unless specifically indicated in the Drawings or approved in writing by the Engineer. All field welding shall comply with Section 05 05 23 – Metal Fastening.

F. All bolted connections shall use high strength bolts in accordance with Section 05 05 23 – Metal Fastening. High strength bolts shall be installed in accordance with RCSC "Specification for Structural Joints Using High Strength Bolts". Bolts specified or noted on the Drawings to be a tension or slip critical "SC" type connection shall be fully pretensioned with proper preparation of the faying surfaces. All other bolts shall be snug tightened unless otherwise noted on the Drawings.

G. All field connections shall be accurately fitted up before being bolted. Drifting shall be only such as will bring the parts into position and shall not be sufficient to enlarge the holes or to distort the metal. All unfair holes shall be drilled or reamed.

H. Misfits at Bolted Connections

1. Where misfits in erection bolting are encountered, the Engineer shall be immediately notified. The Contractor shall submit a method to remedy the misfit for review by the Engineer. The Engineer will determine whether the remedy is acceptable or if the member must be refabricated.

2. Incorrectly sized or misaligned holes in members shall not be enlarged by burning or by the use of drift pins. The Contractor shall notify the Engineer immediately and shall submit a proposed method of remedy for review by the Engineer.

3. Where misalignment between anchor rods and rod holes in steel members are encountered, the Engineer shall be immediately notified. The Contractor shall submit a method to remedy the misalignment for review by the Engineer.

I. Grouting of Base Plates and Bearing Plates

1. The bottom surface of the plates shall be cleaned of all foreign materials, and concrete or masonry bearing surface shall be cleaned of all foreign materials and roughened to improve bonding.

2. Accurately set all base and bearing plates to designated levels with steel wedges or leveling plates.

3. Baseplates shall be grouted with non-shrink grout to assure full uniform bearing. Grouting shall be done prior to placing loads on the structure. Non-shrink grout shall conform to Section 03 60 00 – Grout.

4. Anchor rods shall be tightened after the supported members have been positioned and plumbed and the non-shrink grout has attained its specified strength.

J. Where finishing is required, assembly shall be completed including bolting and welding of units before start of finishing operations.

3.05 PAINTING

A. Painting shall be performed according to Section 09 90 00 – Painting and the following additional requirements.

1. Concrete Encased Steel: Steel members which will be encased in concrete shall be cleaned but not painted prior to encasement.

2. Contact Surfaces: Contact surfaces such as at field connections, shall be cleaned and primed but not painted.

3. Finished Surfaces: Machine finished surfaces shall be protected against corrosion by a rust-inhibiting coating which is easily removed prior to erection or which has characteristics that make removal unnecessary prior to erection.

4. Surfaces Adjacent to Field Welds: Surfaces within 2 inches of any field weld location shall be free of materials that would prevent proper welding or produce objectionable fumes while welding is being done.

END OF SECTION

SECTION 05 13 00
STAINLESS STEEL

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. The Contractor shall furnish, install and erect the stainless steel work as shown on the Contract Drawings and specified herein.

B. Stainless steel work shall be furnished complete with all accessories, mountings and appurtenances of the type of stainless steel and finish as specified or required for a satisfactory installation.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01 33 00 – Submittal Procedures

B. Section 05 05 23 – Metal Fastening

C. Section 05 10 00 – Metal Materials

D. Section 05 50 00 – Metal Fabrications

1.03 REFERENCES

A. ASTM A193 – Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service

B. ASTM A194 – Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service

C. ASTM A262 – Practice for Detecting Susceptibility to Intergranular Attack in Austenitic Stainless Steel

D. ASTM A276 – Stainless and Heat-Resisting Steel Bars and Shapes

E. ASTM A314 – Stainless and Heat-Resisting Steel Billets and Bars for Forging

F. ASTM A380 – Practice for Cleaning and Descaling Stainless Steel Parts, Equipment and Systems

G. ASTM A473 – Stainless and Heat-Resisting Steel Forgings

H. ASTM A666 – Austenitic Stainless Steel, Sheet, Strip, Plate and Flat Bar

I. ASTM A774 – Stainless Steel Pipe Fittings

020924

J. ASTM A778 – Stainless Steel Pipe

K. ASTM A967 – Standard Specification for Chemical Passivation Treatments for Stainless Steel Parts

L. ASTM F593 – Stainless Steel Bolts, Hex Cap Screws and Studs

M. ASTM F594 – Stainless Steel Nuts

N. ANSI/ASME B1.1 – Unified Inch Screw Thread (UN and UNR Thread Form)

1.04 TESTS

A. All stainless steel materials including stainless test welds, shall be checked for compliance with tests for susceptibility to intergranular attack. Such tests shall be Practices A, B and E of ASTM A262. Detailed procedures for the tests shall be submitted to the Engineer for approval prior to start of work. Practice A shall be used only for acceptance of materials but not for rejection of materials, and shall be used for screening material intended for testing in Practice B and Practice E. The maximum acceptable corrosion rate under Practice B shall be 0.004 inch per month, rounded off to the third decimal place. If the certified mill report indicates that such test has been satisfactory performed, the fabricator may not be required to repeat the test. Material passing Practice E shall be acceptable.

B. Sample selection for the susceptibility to intergranular attack tests shall be as follows:

1. One (1) sample per heat treatment lot for plates and forgings;

2. One (1) sample per each Welding Procedure Qualification regardless of the joint design;

3. If tests indicate a reduction in corrosion resistance, welding procedure shall be adjusted or heat treatment determined as needed to restore required corrosion resistance.

4. The samples so chosen shall have received all the post-weld heat treatments identical to the finished part.

1.05 SUBMITTALS

A. The Contractor shall prepare and submit for approval shop drawings for all stainless steel fabrication in accordance with Section 01 33 00 – Submittal Procedures.

B. Submittals shall include, but not be limited to, the following:

1. Certified test reports for susceptibility to intergranular attack.

2. Affidavit of compliance with type of stainless steel shown on the Contract Drawings or specified herein.

3. Certified weld inspection reports.

4. Cleaning and handling of stainless steel in accordance with Paragraph 3.04, Cleaning and Handling.

C. Samples of finish, on each type of stainless steel to be furnished, shall be submitted to the Engineer upon request.

1.06 QUALITY ASSURANCE

A. Shop inspections may be made by the Engineer. The Contractor shall give ample notice to the Engineer prior to the beginning of any stainless steel fabrication work so that inspection may be provided. The Contractor shall furnish all facilities for the inspection of materials and workmanship in the shop, and the inspectors shall be allowed free access to the necessary parts of the works.

B. Inspectors shall have the authority to reject any materials or work which does not meet the requirements of the Contract Drawings or the Specifications.

C. Inspection at the shop is intended as a means of facilitating the work and avoiding errors, but is expressly understood that it will in no way relieve the Contractor from the responsibility for furnishing proper materials or workmanship.

1.07 HANDLING, STORAGE AND DELIVERY

A. Mechanical damage (e.g., scratches and gouges) to the stainless steel material shall not be permitted and is cause for rejection. Care shall be taken in the material handling since such mechanical damage will result in the passive oxide film being "punctured" leading to a possible lower resistance to the initiation of corrosion than the surrounding chemically-passivated surface.

B. Stainless steel plates and sheets shall be stored vertically in racks and not be dragged out of the racks or over one another. Racks shall be protected to prevent iron contamination.

C. Heavy stainless steel plates shall be carefully separated and chocked with wooden blocks so that the forks of a fork-lift could be inserted between plates without mechanically damaging the surface.

D. Stainless steel plates and sheets laid out for use shall be off the floor and be divided by wooden planks to prevent surface damage and to facilitate subsequent handling.

E. Plate clamps, if used, shall be used with care as the serrated faces can dig in, indent and gouge the surface.

F. Stainless steel fabrications shall be loaded in such a manner that they may be transported and unloaded without being overstressed, deformed or otherwise damaged.

G. Stainless steel fabrications and packaged materials shall be protected from corrosion and deterioration and shall be stored in a dry area. Materials stored outdoors shall be supported above ground surfaces on wood runners and protected with approved effective and durable covers.

H. Stainless steel fabrications shall not be placed in or on a structure in a manner that might cause distortion or damage to the fabrication. The Contractor shall repair or replace damaged stainless steel fabrications or materials as directed by the Engineer.

1.08 FIELD MEASUREMENTS

A. The Contractor shall verify all dimensions and shall make any field measurements necessary and shall be fully responsible for accuracy and layout of the work.

B. The Contractor shall review the Contract Drawings and any discrepancies shall be reported to the Engineer for clarification prior to starting fabrication.

PART 2 – PRODUCTS

2.01 MATERIALS AND FINISHES

A. Stainless steel shall be Type 316.

B. Minimum mechanical finish shall be a polished surface obtained by finishing with a 120-150 mesh abrasive, following initial grinding with coarser abrasives.

PART 3 – EXECUTION

3.01 FABRICATION

A. Holes for bolts and screws shall be drilled. Fastenings shall be concealed where practicable. Joints exposed to the weather shall be formed to exclude water.

B. As far as practicable, all fabricated units shall be fitted and assembled in the shop, with all cuts and bends made to precision measurements in accordance with details shown on approved shop drawings.

C. Work shall be fabricated so that it is installed in a manner that will provide for expansion and contraction, prevent the shearing of bolts, screws and other fastenings, ensure rigidity, and provide close fitting of sections.

D. All finished and/or machined faces shall be true to line and level. Stainless steel sections shall be well formed to shape and size with sharp lines and angles; curved work shall be sprung evenly to curves.

E. All work shall be fitted together at the shop as far as possible, and delivered complete and ready for erection. Proper care shall be exercised in handling all work so as not to injure the finished surfaces.

3.02 WELDING

A. Welding shall be done in a manner that will prevent buckling and in accordance with Section 05 05 23 – Metal Fastening, and as modified hereinafter.

B. All welds exposed in the work shall be ground smooth and finished to match the finish of the adjacent stainless steel surfaces.

C. Select weld rods that provide weld filler metal having corrosion resistant properties as nearly identical or better than the base metal to insure preservation of the corrosion-resistant properties. Provide heat treatment at welds where testing of weld procedure indicates it is required to restore the corrosion resistance.

D. Thermal conductivity of stainless steel is about half that of other steels; and the following methods may be used to accommodate this situation:

1. Use lower weld current setting.

2. Use skip-weld techniques to minimize heat concentration.

3. Use back-up chill bars or other cooling techniques to dissipate heat.

E. Edges of the stainless steel to be welded shall be cleaned of contaminants.

3.03 FASTENERS

A. Stainless steel fasteners shall be used for joining stainless steel work.

B. Stainless steel fasteners shall be made of alloys that are equal to or more corrosion resistant than the materials they join.

3.04 CLEANING AND HANDLING

A. All stainless steel surfaces shall be precleaned, descaled, passivated and inspected before, during and after fabrication in accordance with the applicable sections of ASTM A380 and as detailed in the procedures to be submitted to the Engineer for approval prior to start of work. Chemical passivation in accordance with ASTM A967 is required for all stainless steel in contact with process water. Degreasing and passivation of stainless steel articles shall be conducted as the last step after fabrication.

B. Measures to protect cleaned surfaces shall be taken as soon as final cleaning is completed and shall be maintained during all subsequent handling, storage and shipping.

1. The Contractor shall submit for approval specific procedures listing all the steps to be followed in detecting contamination and in descaling, cleaning, passivation and protecting of all stainless steel.

2. Area showing clear indications of contamination shall be recleaned, repassivated and reinspected.

C. At approved stages in the shop operations, contaminants such as scale, embedded iron, rust, dirts, oil, grease and any other foreign matter shall be removed from the metal, as directed or approved by the Engineer. The adequacy of these operations shall be checked by the Engineer. Operations in the shop shall be conducted so as to avoid contamination of the stainless steel and to keep the metal surfaces free from dirt and foreign matter.

D. In order to prevent incipient corrosion during fabrication, special efforts shall be made at all times to keep all stainless steel surfaces from coming in contact with other metals.

1. Stainless steel and stainless steel welds shall be cleaned with clean sand free of iron, stainless steel wool, stainless steel brushes, or other approved means and shall be protected at all times from contamination by any materials, including carbon steel, that shall impair its resistance to corrosion.

2. Approved methods of cutting, grinding and handling shall be used to prevent contamination. If air-arc, or carbon-arc cutting is used, additional metal shall be removed by approved mechanical means so as to provide clean, weldable edges. All grinding of stainless steel shall be performed with aluminum oxide or silicon carbide grinding wheels bonded with resin or rubber. Grinding wheels used on carbon steel shall not be used on stainless steel.

3. Sand, grinding wheels, brushes and other materials used for cleaning stainless steel shall be checked periodically by the Engineer for contaminants. Cleaning aids found to contain contaminants shall not be used on the work.

3.05 INSTALLATION

A. All stainless steel fabrications shall be erected square, plumb and true, accurately fitted, adequately anchored in place, set at proper elevations and positions.

B. All inserts, anchor rods and all other miscellaneous work specified in the Detailed Specifications or shown on the Contract Drawings or required for the proper completion of the work, which are embedded in concrete, shall be properly set and securely held in position in the forms before the concrete is placed.

C. All stainless steel fabrications shall be installed in conformance with details shown on the Contract Drawings or on the approved shop drawings.

END OF SECTION

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SECTION 05 50 00
METAL FABRICATIONS

PART 1 – GENERAL

1.01 REQUIREMENT

A. Furnish all materials, labor, and equipment required to provide all metal fabrications not specifically included in other Sections, complete and in accordance with the requirements of the Contract Documents.

B. Work shall include but may not be limited to lintels, guard posts, hoppers, and chutes.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 05 10 00 – Metal Materials

B. Section 05 05 23 – Metal Fastening

C. Section 05 05 13 – Galvanizing

D. Certain specific items are included in other Sections of the Specifications. See the section for the specific item in question.

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of other requirements of the Specifications, all work specified herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.

1. Florida Building Code

2. AISC – Specification for Structural Steel Buildings

3. AISI – Specifications for the Design of Cold-Formed Steel Structural Members

4. Aluminum Association Specifications for Aluminum Structures

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittal Procedures.

1. Complete fabrication and erection drawings of all metalwork specified herein.

2. Other submittals as required in accordance with Section 05 10 00 – Metal Materials and Section 05 05 23 – Metal Fastening.

PART 2 – PRODUCTS

2.01 METAL MATERIALS

A. Metal materials used in metal fabrications shall conform to Section 05 10 00 – Metal Materials, unless noted otherwise.

2.02 METAL FASTENING

A. All welds and fasteners used in metal fabrication shall conform to Section 05 05 23 – Metal Fastening, unless noted otherwise.

2.03 LINTELS

A. Provide lintels as shown on the Drawings and specified herein with 8 inches minimum bearing each side unless noted otherwise.

B. All lintels shall be steel in accordance with Section 05 12 00 – Structural Steel and shall be galvanized in accordance with Section 05 05 13 – Galvanizing, unless noted otherwise.

2.04 GUARD POSTS (BOLLARDS)

A. Guard posts shall be 6-inch diameter Schedule 40 galvanized steel pipe in accordance with ASTM A53.

B. Guard posts shall be concrete filled and crowned, as detailed in the Drawings.

PART 3 – EXECUTION

3.01 FABRICATION

A. All measurements and dimensions shall be based on field conditions and shall be verified by the Contractor prior to fabrication. Such verification shall include coordination with adjoining work.

B. All fabricated work shall be shop fitted together as much as practicable, and delivered to the field, complete and ready for erection. All miscellaneous items such as stiffeners, fillets, connections, brackets, and other details necessary for a complete installation shall be provided.

C. All work shall be fabricated and installed in a manner that will provide for expansion and contraction, prevent shearing of bolts, screws, and other fastenings, ensure rigidity, and provide a close fit of sections.

D. Finished members shall conform to the lines, angles, and curves shown on the Drawings and shall be free from distortions of any kind.

E. All shearings shall be neat and accurate, with parts exposed to view neatly finished. Flame cutting is allowed only when performed utilizing a machine.

F. All shop connections shall be welded unless otherwise indicated on the Drawings or specified herein. Bolts and welds shall conform to Section 05 05 23 – Metal Fastening. All fastenings shall be concealed where practicable.

G. Fabricated items shall be shop painted when specified in Section 09 90 00 – Painting.

3.02 INSTALLATION

A. Assembly and installation of fabricated system components shall be performed in strict accordance with manufacturer's recommendations.

B. All miscellaneous metalwork shall be erected square, plumb and true, accurately fitted, adequately anchored in place, and set at proper elevations and positions.

C. Metal work shall be field painted when as specified in accordance with Section 09 90 00 – Painting.

END OF SECTION

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SECTION 05 51 00
METAL STAIRS

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. Furnish all materials, labor, and equipment required to provide all metal stairs in accordance with the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 05 10 00 – Metal Materials

B. Section 05 05 13 – Galvanizing

C. Section 05 05 23 – Metal Fastening

D. Section 05 12 00 – Structural Steel

E. Section 05 52 00 – Guards and Railings

F. Section 05 53 00 – Gratings, Checkered Floor Plates, and Access Doors

G. Section 05 55 00 – Stair Treads and Nosings

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.

1. Florida Building Code
2. AISC – Specification for Structural Steel Buildings
3. AISI – Specification for the Design of Cold-Formed Steel Structural Members
4. Aluminum Association Specifications for Aluminum Structures

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittal Procedures.

1. Complete fabrication and erection drawings of all metal work specified herein.

2. Other submittals as required in accordance with Section 05 10 00 – Metal Materials and Section 05 05 23 – Metal Fastening.

3. Submit structural calculations and detailed erection drawings for steel pan stairs. Calculations and drawings shall be signed and sealed by a Professional Engineer currently registered in the State or Commonwealth in which the project is located.

PART 2 – PRODUCTS

2.01 METAL MATERIALS

A. Metal materials used for metal stairs shall conform to Section 05 10 00 – Metal Materials, unless noted otherwise.

2.02 METAL FASTENING

A. All welds and fasteners used in metal stairs shall conform to Section 05 05 23 – Metal Fastening, unless noted otherwise.

2.03 METAL STAIRS AND LANDINGS

A. Stair stringers and structural framing of landings shall be fabricated from steel or aluminum as indicated on the Drawings.

1. Steel stairs shall be fabricated from steel in accordance with Section 05 12 00 – Structural Steel.

2. Aluminum stairs shall be fabricated from aluminum alloy 6061-T6.

B. Regardless of material of stringers, all stair treads shall be aluminum in accordance with Section 05 55 00 – Stair Treads and Nosings.

C. Where metal landings are required as indicated on the Drawings, gratings at landings shall conform to Section 05 53 00 – Gratings, Checkered Floor Plates, and Access Doors.

D. Guards for metal stairs shall conform to Section 05 52 00 – Guards and Railings. Contractor shall coordinate attachment of guards to metal stairs.

E. All clips, anchors, and necessary appurtenances shall be provided for a complete and rigid installation.

F. Closure plates shall be provided for all exposed ends of stringers.

G. All exposed connections shall be welded and ground smooth, unless otherwise indicated on the Drawings.

H. Stairs and landings shall be designed to support a 100 psf live load, minimum, unless otherwise indicated on the Drawings.

2.04 STEEL PAN STAIRS (NOT USED)

2.05 ALTERNATING TREAD STAIRS (NOT USED)

PART 3 – EXECUTION

3.01 FABRICATION

A. All measurements and dimensions shall be based on field conditions and shall be verified by the Contractor prior to fabrication. Such verification shall include coordination with all adjoining work.

B. All fabricated work shall be shop fitted together as much as practicable, and delivered to the field, complete and ready for erection. All miscellaneous items such as stiffeners, fillets, connections, brackets, and other details necessary for a complete installation shall be provided.

C. All work shall be fabricated and installed in a manner that will provide for expansion and contraction, prevent shearing of bolts, screws, and other fastenings, ensure rigidity, and provide a close fit of sections.

D. Finished members shall conform to the lines, angles, and curves shown on the drawings and shall be free from distortions of any kind.

E. All shearings shall be neat and accurate, with parts exposed to view neatly finished. Flame cutting is allowed only when performed utilizing a machine.

F. All shop connections shall be welded unless otherwise indicated on the Drawings or specified herein. Bolts and welds shall conform to Section 05 05 23 – Metal Fastening. All fastenings shall be concealed where practicable.

G. Fabricated items shall be shop painted when specified in accordance with Section 09 90 00 – Painting.

3.02 INSTALLATION

A. Assembly and installation of metal stairs shall be performed in strict accordance with manufacturer's recommendations.

B. All miscellaneous metalwork shall be erected square, plumb and true, accurately fitted, adequately anchored in place, and set at proper elevations and positions.

C. Metal stairs shall field painted when specified in accordance with Section 09 90 00 – Painting.

END OF SECTION

SECTION 05 51 33
LADDERS

PART 1 – GENERAL

1.01 REQUIREMENT

A. Furnish all materials, labor, and equipment required to provide all ladders in accordance with the requirements of the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 05 10 00 – Metal Materials

B. Section 05 05 23 – Metal Fastening

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of the Specifications, all work specified herein shall conform to the applicable requirements of the following documents.

1. Florida Building Code

2. Aluminum Association Specifications for Aluminum Structures

3. Occupational Safety and Health Administration (OSHA) Regulations

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittal Procedures.

1. Complete fabrication and erection drawings of all metalwork specified herein.

2. Other submittals as required in accordance with Section 05 10 00 – Metal Materials and Section 05 05 23 – Metal Fastening.

PART 2 – PRODUCTS

2.01 METAL MATERIALS

A. Metal materials used for ladders shall conform to Section 05 10 00 – Metal Materials, unless noted otherwise.

2.02 METAL FASTENING

A. All welds and fasteners used for ladders shall conform to Section 05 05 23 – Metal Fastening, unless noted otherwise.

2.03 LADDERS

A. Ladders shall be furnished with all mounting brackets, baseplates, fasteners, and necessary appurtenances for a complete and rigid installation.

B. Unless noted otherwise on the Drawings, all ladders shall be aluminum alloy 6061-T6 or 6063-T5, with a clear, anodized finish, Aluminum Association M12C22A41.

C. All ladders shall conform to dimensions indicated on the Drawings and shall comply with OSHA requirements.

D. Side rails shall be 1-1/2 inch diameter Schedule 80 pipe, minimum.

E. Rungs shall be serrated 3/4 inch diameter, minimum.

F. All exposed connections shall be welded and ground smooth.

G. Ladders shall be as manufactured by Thompson Fabricating Company, or equal.

2.04 LADDER SAFETY SYSTEM

A. All ladders with an uninterrupted climb length exceeding 24 feet between rest platform landings or floors shall be installed with a ladder safety system.

B. Ladder safety system shall comply with all OSHA requirements and meet ANSI A14.3 design requirements.

C. Ladder safety system shall include all necessary components to provide a fully operational system, including one full body safety harness with a 310 lb. weight capacity for each ladder safety system.

D. Ladder Safety Systems shall be Miller Vi-Go by Honeywell, LAD_SAF by DBI Sala, or approved equal.

2.05 LADDER RETRACTABLE SAFETY EXTENSION

A. Where the Contract Documents indicate fixed ladders are required under access doors and checkered floor plates, they shall be provided with “LadderUp, Model LU-4” by Bilco Company, “L1E Ladder Extension” by Halliday Products Inc., or “Ladder Climb-out Device” by Thompson Fabricating.

1. For access doors, the safety extension shall be manufactured from the same material as the access door with telescoping tubular sections that lock automatically when fully extended.

2. Upward and downward movement shall be controlled by a stainless-steel balancing mechanism.

3. Safety extension shall be assembled in strict accordance with manufacturer's recommendations.

PART 3 – EXECUTION

3.01 FABRICATION

A. All measurements and dimensions shall be based on field conditions and shall be verified by the Contractor prior to fabrication. Such verification shall include coordination with adjoining work.

B. All fabricated work shall be shop fitted together as much as practicable, and delivered to the field, complete and ready for erection.

C. All work shall be fabricated and installed in a manner that will provide for expansion and contraction, prevent shearing of bolts, screws, and other fastenings, ensure rigidity, and provide a close fit of sections.

D. Finished members shall conform to the lines, angles, and curves shown on the Drawings and shall be free from distortions of any kind.

E. All shearings shall be neat and accurate, with parts exposed to view neatly finished. Flame cutting is allowed only when performed utilizing a machine.

F. All shop connections shall be welded unless otherwise indicated on the Drawings or specified herein. Bolts and welds shall conform to Section 05 05 23 – Metal Fastening. All fastenings shall be concealed where practicable.

G. Fabricated items shall be shop painted when specified in accordance with Section 09 90 00 – Painting.

3.02 INSTALLATION

A. Assembly and installation of fabricated system components shall be performed in strict accordance with manufacturer's recommendations.

B. All miscellaneous metalwork shall be erected square, plumb and true, accurately fitted, adequately anchored in place, and set at proper elevations and positions.

C. Metalwork shall be field painted when specified in accordance with Section 09 90 00 – Painting.

END OF SECTION

SECTION 05 52 00
GUARDS AND RAILINGS

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. Furnish all materials, labor, and equipment required to provide all metal guards and railings in accordance with the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 05 10 00 – Metal Materials

B. Section 05 05 23 – Metal Fastening

C. Section 06 51 00 – Glass Fiber and Resin Fabrications

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.

1. Florida Building Code

2. Aluminum Association Specifications for Aluminum Structures

3. Occupational Safety and Health Administration (OSHA) Regulations

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittal Procedures.

1. Complete fabrication and erection drawings of all metal work specified herein, sealed by a Professional Engineer currently licensed in the State of Florida.

2. Other submittals as required in accordance with Section 05 10 00 – Metal Materials and Section 05 05 23 – Metal Fastening.

3. Structural calculations on guard and handrail system sealed by a Professional Engineer currently licensed in the State of Florida.

PART 2 – PRODUCTS

2.01 METAL MATERIALS

A. Metal materials used for guards and railings shall conform to Section 05 10 00 – Metal Materials, unless noted otherwise.

2.02 METAL FASTENING

A. All welds and fasteners used in guards and railings shall conform to Section 05 05 23 – Metal Fastening, unless noted otherwise.

2.03 GUARDS AND RAILINGS

A. General – Design of guard and handrail systems is the exclusive responsibility of the Contractor. Guard systems shall consist of all railings, posts, toeboards, baseplates, anchors, and accessories required for a complete and rigid installation.

1. All guard systems shall be fabricated from extruded aluminum alloy 6061-T6 or 6105-T5, with Aluminum Association M12C22A41 finish, unless otherwise noted.

2. Metal railings shall be fabricated from 1-1/2 inch Schedule 40 minimum pipe. Metal railing support posts shall be fabricated from 1-1/2 inch Schedule 80 minimum pipe.

3. The top of the upper guard rail shall be 42 inches above the walking surface for level guards. For stair guards, the top of the upper guard rail shall be 42 inches above the leading edge of the tread nosing. The top of stair handrail shall be 34 inches above the leading edge of the tread nosing.

4. Posts

    a. Maximum horizontal spacing between posts for level rail shall be six feet.

    b. Maximum horizontal spacing between posts for stair rail shall be five feet.

5. All rail joints shall be finished flush and shall occur only at supports. Posts shall not interrupt the continuation of the top rail at any point along the railing, including corners and end terminations. The top surface of the top railing shall be smooth and shall not be interrupted by projecting fittings.

6. Toeboards

    a. Toeboards shall project 4-inches above the walking surface and shall not infringe on the minimum required walkway width.

    b. Aluminum toeboards shall be extruded from aluminum alloy 6063-T6 unless otherwise noted.

c. Toeboards shall have a minimum thickness of 1/8" at any point. Geometry of toeboard shall closely resemble geometry shown on Drawings.

7. Expansion joint splices shall be provided at 30 foot maximum spacing and at all expansion joints in the structure supporting the guards.

8. The guard system shall be designed to resist the design loads specified by both OSHA and the Florida Building Code.

9. Provide handrail extensions at top and bottom of stairs and ramps in accordance with the Florida Building Code.

B. The Contractor shall have the option of providing a guard system of either an all welded type construction or a component type construction.

1. With both the all welded or component type construction, the baseplates and toeboards shall be furnished as shown on the Drawings.

2. Component Type System

a. All fittings and brackets shall be designed for stainless steel concealed set screws with internal tyne type connectors.

b. Exposed fittings shall be cast or extruded aluminum, or stainless steel to match guard material, except where corrosion-resistant steel is employed as a standard fabricator's item for use.

c. Component type guards shall be as manufactured by Thompson Fabricating Company, Inc., or Hollaender Manufacturing Company, Inc.

3. Welded guards may be field assembled using component type fittings as described herein.

C. Guards shall be either Type I or Type II guards as shown on the Drawings. If no type is indicated on Drawings, guards shall be Type I.

1. Type I guards shall be a two-rail system. The intermediate rail shall be located as required to prevent passage of a 21-inch diameter sphere at any point.

2. Type II guards shall be a three-rail system with vertical posts spanning between the two intermediate rails.

a. The centerline of the lower intermediate rail shall be 7 inches above the walking surface.

b. The upper intermediate members, whether additional rails or vertical posts, shall be located below the top rail at a spacing as required to prevent passage of a 4-inch diameter sphere between the two rails.

c. Vertical posts spanning between the intermediate rails shall be 1/2" diameter schedule 40 pipe or fiberglass rod.

d. Spacing of vertical posts shall be as required to prevent passage of a 4-inch diameter sphere at any point.

D. Where gates are required in guards as shown on the Drawings, they shall be self-closing and shall be provided by the same manufacturer as the guards. Gates shall swing away from the opening being protected by the guards.

E. Where safety chains are required in guards as shown on the Drawings, chains shall be constructed of Type 304 stainless steel. Chains shall be straight link style, 3/16-inch diameter, with at least twelve links per foot, and with snap hooks on each end. Snap hooks shall be boat type and eye bolts for attachment of chains shall be 3/8-inch bolts with 3/4-inch eye diameter welded to the railing posts. Two (2) chains, four inches longer than the anchorage spacing shall be supplied for each guarded area.

2.04 FREE STANDING RAILING SYSTEM

A. Free standing railing system shall be installed on roof ledges where accessible equipment is provided on roof and roof does not have a perimeter parapet wall of a minimum height of 42 inches. Free standing railing system shall be Safety Rail 2000 Guardrail System by BlueWater Mfg., Inc. or approved equal.

B. Toe Board brackets shall be used when the parapet wall is less than 3-1/2” in height.

C. Performance Characteristics: Shall meet and exceed OSHA (Standards - 29 CFR) 1926.502 (b).

1. Railing System shall be designed to withstand a minimum 200 pounds of test load in any direction.

2. Railing System shall consist of a top rail and rail at mid height between top rail and walking surface.

3. Railing system shall extend to a height of at least 42" from the finished roof deck.

4. Railing system shall be free of sharp edges and snag points.

D. Railing and Base

1. Rail shall be 1 5/8” O.D. Hot Rolled Pickled Electric Weld Tubing

2. Each support post shall have a free standing base cast from Class 30 Gray Iron material.

3. Each base shall have four (4) receiver posts for accepting the rails.

4. The receiver posts shall have a positive locking system. A friction locking system will not be acceptable.

5. The receiver posts shall have a slot to enable the rails to be mounted in any direction.

E. Hardware

1. The securing pins shall be made from 1010 carbon steel. The pins shall be zinc plated and yellow chromate dipped. The pins shall consist of a collared pin and a lanyard that connects to a lynch pin.

2. For Gate Assemblies Only. Bolts and washers shall be 3/8" x 3 ½" and 3/8" x 3" grade 5, zinc plated.

3. Finish

a. Rails: Specify factory finish Safety Yellow Powder Coat Paint, Hot Dipped Galvanized or a color to match the building.

b. Bases: Specify factory finish Safety Yellow Powder Coat Paint, Hot Dipped Galvanized or a color to match the building.

PART 3 – EXECUTION

3.01 FABRICATION

A. All measurements and dimensions shall be based on field conditions and shall be verified by the Contractor prior to fabrication. Such verification shall include coordination with all adjoining work.

B. All fabricated work shall be shop fitted together as much as practical, and delivered to the field, complete and ready for erection.

C. All work shall be fabricated and installed in a manner that will provide for expansion and contraction, prevent shearing of bolts, screws, and other fastenings, ensure rigidity, and provide a close fit of sections.

D. Finished members shall conform to the lines, angles, and curves shown on the drawings and shall be free from distortions of any kind.

E. All shearings shall be neat and accurate, with parts exposed to view neatly finished. Flame cutting is allowed only when performed utilizing a machine.

F. Concrete anchors and bolts for attachment of guard baseplates to supporting members shall conform to Section 05 05 23 – Metal Fastening.

G. All fabricated items shall be shop painted in accordance with Section 09 90 00 – Painting.

3.02 INSTALLATION

A. Assembly and installation of guards and railings shall be performed in strict accordance with manufacturer's recommendations.

B. All guards and railings shall be erected square, plumb and true, accurately fitted, adequately anchored in place, and set at proper elevations and positions.

END OF SECTION

SECTION 05 53 00

GRATINGS, CHECKERED FLOOR PLATES, AND ACCESS DOORS

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. Furnish all materials, labor, and equipment required to provide all gratings, floor plates, and access doors in accordance with the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 05 10 00 – Metal Materials

B. Section 05 05 13 – Galvanizing

C. Section 05 05 23 – Metal Fastening

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.

1. Florida Building Code

2. Aluminum Association Specifications for Aluminum Structures

3. Occupational Safety and Health Administration (OSHA) Regulations

4. ANSI/NAAMM MBG 531 – NAAMM Metal Bar Grating Manual

5. ASTM C1802 – Design, Testing, Manufacture, Selection, and Installation of Fabricated Metal Access Hatches for Utility, Water, and Wastewater Structures

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittal Procedures.

1. Complete fabrication and erection Drawings of all gratings, floor plates, and access doors specified herein.

2. For checkered floor plates, structural calculations signed and sealed by a currently registered Professional Engineer in the State or Commonwealth in which the Project

is located verifying the proposed floor plate meets the minimum load and deflection requirements stipulated herein.

3. For access doors provided by a manufacturer not specifically named herein, structural calculations signed and sealed by a Professional Engineer currently registered in the State or Commonwealth in which the Project is located verifying the proposed access door meets the minimum load and deflection requirements stipulated herein. For access doors provided by a named manufacturer, sealed calculations are not required provided the applicable ASTM C1802 load rating is clearly indicated in the submittal for each proposed product.

4. Other submittals as required in accordance with Section 05 10 00 – Metal Materials and Section 05 05 23 – Metal Fastening.

PART 2 – PRODUCTS

2.01 METAL MATERIALS

A. Metal materials used for gratings, floor plates, and access doors shall conform to Section 05 10 00 – Metal Materials, unless noted otherwise.

2.02 METAL FASTENING

A. All welds and fasteners used for gratings, floor plates, and access doors shall conform to Section 05 05 23 – Metal Fastening, unless noted otherwise.

2.03 GRATING

A. General - Grating, including support frames, fastenings, and all necessary appurtenances for a complete installation, shall be furnished as indicated on the Drawings.

1. All exposed bearing ends of grating shall be enclosed in a perimeter band of the same dimensions and material as the main bars, including ends at all cutouts.

2. Grating shall be fabricated into easily removable sections and shall be fastened at each corner and as required with fasteners provided by the grating manufacturer. No fasteners shall be permitted to project above the walking surface.

3. Grating shall be designed for a loading of 150 psf unless otherwise required by the Drawings. Grating deflection shall not exceed 1/4 inch under a uniform load of 150 psf. Minimum grating depth shall be 1-1/2 inches, unless structural requirements based on clear span require more depth.

4. Grating installed in cast-in-place concrete shall be provided with embedded support frames on all perimeter and bearing edges. Support frames shall be extruded frames

with continuous means of anchoring frames to concrete around entire perimeter of frame. Support frames shall be fabricated from the same material as the grating.

B. Aluminum Grating

1. Aluminum grating shall be of I-bar type and shall consist of extruded bearing bars positioned and locked by crossbars. All supports, cross members, etc. shall be aluminum. Plank clips for grating attachment to frames and any other required attachments, shall be aluminum or stainless steel. Bolts shall be stainless steel. Provide embedded aluminum support frames for cast-in-place concrete installations.

2. Grating shall be “IB” by Harsco Industrial IKG, “I-Bar 19SGI4", by Ohio Grating Inc., or “I-Bar” by Thompson Fabricating LLC.

C. Aluminum Plank Grating

1. Aluminum plank grating shall be unpunched planks of extruded aluminum welded together to form panels. Panel ends shall have an extruded aluminum end bar welded in place. Two stainless steel recessed lifting handles shall be provided for individual panels, one handle at each end, where specifically shown on drawings. All support members shall be aluminum. Plank clips for grating attachment to frames and any other required attachments, shall be aluminum or stainless steel. Bolts shall be stainless steel. Provide embedded aluminum support frames for cast-in-place concrete installations.

2. Aluminum plank grating shall be HD-P manufactured by Harsco Industrial IKG., Heavy Duty Series manufactured by Ohio Gratings, Inc., or Unpunched Duo-Grip Extruded Series manufactured by Alabama Metal Industries Corporation (AMICO).

D. Heavy Duty Steel Grating

1. Heavy duty steel grating shall be galvanized according to Section 05 05 13 – Galvanizing.

2. Main bearing bars shall conform to ASTM A36. Cross bars shall be flush with the top of the grating. Provide embedded galvanized steel support frames for cast-in-place concrete installations.

3. Grating span shall be 36 inches maximum and shall satisfy AASHTO loading for HS-20 truck.

4. Grating shall be manufactured by Harsco Industrial IKG and Ohio Gratings, Inc.

2.04 CHECKERED FLOOR PLATES

A. Floor plates shall meet the requirements of ASTM C1802 for Load Level 1 – Light Pedestrian Load, minimum, unless otherwise indicated on the Drawings.

B. Floor plates shall be aluminum unless noted otherwise.

C. All floor plates shall be checkered plate with an approved raised pattern, non-skid surface.

D. Openings greater than 42 inches in either direction shall require two plates opening via hinges in opposite directions.

E. Floor plates shall be designed to carry a minimum service level live load of 150 psf, or a concentrated load of 300 pounds applied over a 5.50 inch by 5.50 inch area, whichever produces the greatest stress, unless indicated otherwise on the Drawings. Loading shall be positioned to produce the greatest stresses, both due to maximum moment and maximum shear load conditions.

F. All components of checkered floor plates shall have a minimum tensile yield strength of 23,000 psi and a minimum compressive yield strength of 21,000 psi. Yield strengths shall be indicated on both the structural calculations and the fabrication drawings.

G. Live load deflection shall be limited to L/200 of the span, but no greater than 3/16 inch.

H. All checkered floor plates shall be fabricated from 1/4" plate, minimum and shall be stiffened as required to maintain allowable stress and deflection requirements specified herein.

I. Stiffeners shall consist of angles or bars welded to the bottom of the plate.

J. Checkered floor plate hinges shall be either stainless steel or aluminum with stainless steel pins and fasteners.

K. All checkered floor plates shall be provided with recessed handles. Handle material shall be as shown on the Contract Drawings.

L. Air-tight and water-tight checkered floor plates shall be provided with a 1/8-inch-thick neoprene gasket between the checkered plate and the support frame. Gasket material shall be bonded to the support frame and checkered floor plates shall be bolted to the structural support frame with countersunk stainless-steel flathead screws.

M. All floor plates shall be clearly marked with the information listed below. Markings shall be indicated on metal or plastic tags permanently attached to the floor plate or frame or shall be permanently painted or printed.

    1. The manufacturer’s name or trademark, location, and telephone contact number.

2. The manufacturer's model number and ASTM designation.

3. The design load level as indicated in ASTM C1802. If the design requires deviation from the Load Level requirements specified in ASTM C1802, a description of the modifications shall be included.

4. Date of manufacture and/or serial number.

2.05 ACCESS DOORS

A. General

1. Door opening sizes, number, and direction of swing of door leaves, and locations shall be as shown on the Drawings. The Drawings shall indicate the dimensions of the openings in the concrete. Clear opening dimensions shall be no smaller than six inches less than the concrete opening.

2. All doors shall be aluminum unless otherwise noted.

3. All door components shall have a minimum tensile yield strength of 23,000 psi and a minimum compressive yield strength of 21,000 psi. Yield strengths shall be indicated on both the structural calculations and the fabrication drawings.

4. Openings larger than 42 inches in either direction shall have double leaf doors.

5. Doors shall be designed for flush mounting and for easy opening from both inside and outside.

6. All doors shall be provided with an automatic hold-open arm with release handle.

7. Double leaf doors shall be provided with safety bars to go across the open sides of the door, when in the open position. Brackets shall be provided on the underside of the doors to hold the safety bars when not in use.

8. All hardware, including but not limited to, all parts of the latch and lifting mechanism assemblies, hold open arms and guides, brackets, hinges, springs, pins, and fasteners shall be stainless steel.

9. All doors specifically required to be watertight shall be installed with a continuous gasket.

10. Access door frames with integral gutter systems shall be equipped with a 1-1/2-inch minimum drainpipe located by the manufacturer. The drainpipe shall be provided by the Contractor and shall extend to the nearest point of discharge acceptable to the Engineer.

11. All doors shall be clearly marked with the information listed below. Markings shall be indicated on metal or plastic tags permanently attached to the door or frame or shall be permanently painted or printed.

    a. The manufacturer's name or trademark, location, and telephone contact number.

    b. The manufacturer's model number and ASTM designation.

    c. The design load level as indicated in ASTM C1802. If the design requires deviation from the Load Level requirements specified in ASTM C1802, a description of the modifications shall be included.

    d. The nominal door opening dimensions and/or the manufacturer's model number.

    e. Date of manufacture and/or serial number.

B. Floor, Wet Well and Dry Pit Access Doors

1. Door leaves shall be 1/4 inch, minimum, diamond pattern plate with an approved raised pattern, non-skid surface. Plate shall be stiffened as required to maintain allowable stress and deflection requirements. Stiffeners shall consist of angles or bars welded to the bottom of plate.

2. Doors shall be designed for flush mounting and for easy opening from both inside and outside.

3. All doors shall have an enclosed compression spring assist and open to 90 degrees.

4. Doors not required to support traffic loading shall meet the requirements of ASTM C1802 for Load Level 2 – Pedestrian Load as a minimum and the following:

    a. Doors shall be designed to carry a minimum service level live load of 300 psf or a concentrated load of 600 pounds applied over a 5.50 inch by 5.50 inch area, whichever produces the greatest stress, unless indicated otherwise on the Drawings. Loading shall be positioned to produce the maximum stresses, both due to maximum moment and maximum shear load conditions.

    b. Live load deflection shall be limited to L/200 of the span, but not greater than 3/16 inch.

    c. Unless otherwise noted, exterior doors shall have an integral gutter system and be Type "FDDP" by Nystrom, Type "W1S" or "W2S" by Halliday Products Inc., Type "TPS" or "TPD", by U.S.F. Fabrication Inc., or Type "THG" or "THG-D", by Thompson Fabricating LLC, or Type "J-AL" or "JD_AL" by the Bilco Company.

d. Unless otherwise noted, interior doors shall be Type "FDNP" by Nystrom, Type "S1S" or "S2S" by Halliday Products Inc., Type "APS300" or "APD300", by U.S.F. Fabrication Inc., or Type "TH" or "TH-D", by Thompson Fabricating LLC.

5. Doors required to support traffic loadings shall meet the requirements of ASTM C1802 for Load Level 4 – Occasional Truck Traffic, unless otherwise indicated on the Drawings.

a. For openings less than or equal to 48 inches, the design loading shall consist of a service level 16,000 pound load applied over a 10 inch by 20 inch area with traffic both parallel and perpendicular to the span considered. Loadings shall be positioned to produce the maximum stresses, both due to maximum moment and maximum shear load conditions.

b. For openings greater than 48 inches, two load cases shall be considered. Load Case 1 shall consist of two service level 16,000 pound loads spaced at 48 inches on center with each load applied over a 10 inch by 20 inch area and assuming the traffic direction is perpendicular to the span of the door. Load Case 2 shall consist of two service level 12,500 pound loads spaced at 48 inches on center with each load applied over a 10 inch by 20 inch area and assuming the traffic direction is parallel to the span of the door. Loadings for both cases shall be positioned to produce the maximum stresses, both due to maximum moment and maximum shear load conditions.

c. Live load deflections shall be limited to L/250 of the span, but not greater than 3/16 inch, and shall be determined based off a service level 16,000 pound load.

d. Unless otherwise noted, doors rated for HS-20 traffic loading shall have an integral gutter system and be Type "FDDH" by Nystrom, Type "H1C" or "H2C" by Halliday Products, Inc., Type "THS" or "THD" by U.S.F. Fabrication Inc., Type "THG-H20" by Thompson Fabricating LLC, or "Type JAL-H20" or "JDAL-H20" by the Bilco Company.

C. Roof Access Doors

1. Doors shall be designed for 40 psf live load unless noted otherwise.

2. Doors for service stairs shall be Bilco Type L roof Scuttles.

3. Doors for ladder access shall be Bilco Type S or SS Roof Scuttle.

2.06 FALL THROUGH PREVENTION SYSTEM

A. All checkered floor plates and access doors covering openings measuring 12 inches or more in its least dimension through which persons may fall shall be equipped with a fall through prevention system, except as noted on the Contract Drawings. Checkered floor plates and access doors shall be provided with a permanent installed fall through prevention grate system that provides continuous safety assurance in both its closed and open positions. The grate system shall be made with 6061-T6 aluminum or FRP and be designed for a 300 psf minimum live load, unless noted otherwise.

PART 3 – EXECUTION

3.01 FABRICATION

A. All measurements and dimensions shall be based on field conditions and shall be verified by the Contractor prior to fabrication. Such verification shall include coordination with adjoining work.

B. All fabricated work shall be shop fitted together as much as practicable, and delivered to the field, complete and ready for erection. All miscellaneous items such as stiffeners, fillets, connections, brackets, and other details necessary for a complete installation shall be provided.

C. All work shall be fabricated and installed in a manner that will provide for expansion and contraction, prevent shearing of bolts, screws, and other fastenings, ensure rigidity, and provide a close fit of sections.

D. Finished members shall conform to the lines, angles, and curves shown on the Drawings and shall be free from distortions of any kind.

E. All shearings shall be neat and accurate, with parts exposed to view neatly finished. Flame cutting is allowed only when performed utilizing a machine.

F. All shop connections shall be welded unless otherwise indicated on the Drawings or specified herein. Bolts and welds shall conform to Section 05 05 23 – Metal Fastening. All fastenings shall be concealed where practicable.

3.02 INSTALLATION

A. Assembly and installation of fabricated system components shall be performed in strict accordance with manufacturer's recommendations.

B. All gratings, checkered floor plates, and access doors shall be erected square, plumb and true, accurately fitted, adequately anchored in place, and set at proper elevations and positions. Embedded support frames shall be set level and square.

C. Where access doors utilize leveling bolts, or are placed on irregular surfaces, and are not to be embedded in concrete, the area beneath the frames shall be fully grouted with non-shrink grout to create a uniformly loaded bearing surface.

D. Grating shall not be field cut or modified unless approved by Engineer.

E. Grating shall not be used for equipment support or anchorage.

END OF SECTION

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SECTION 05 55 00
STAIR TREADS AND NOSINGS

PART 1 – GENERAL

1.01 REQUIREMENT

A. Furnish all materials, labor, and equipment required to provide all stair treads and nosings in accordance with the requirements of the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 05 10 00 – Metal Materials

B. Section 05 05 23 – Metal Fastening

C. Section 05 51 00 – Metal Stairs

D. Section 06 51 00 – Glass Fiber and Resin Fabrications

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.

1. Florida Building Code

2. Aluminum Association Specifications for Aluminum Structures.

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittal Procedures.

1. Complete fabrication and erection drawings of all work specified herein.

2. Other submittals as required in accordance with Section 05 10 00 – Metal Materials and Section 05 05 23 – Metal Fastening.

PART 2 – PRODUCTS

2.01 METAL MATERIALS

A. Metal materials used for stair treads and nosings shall conform to Section 05 10 00 – Metal Materials, unless noted otherwise.

2.02 METAL FASTENING

A. All welds and fasteners used for stair treads and nosings shall conform to Section 05 05 23 – Metal Fastening, unless noted otherwise.

2.03 SAFETY STAIR NOSINGS

A. Abrasive cast aluminum, safety stair nosings shall be provided on all concrete or concrete filled steel pan stairs, including the top stair of metal stairs that attach to concrete, and as shown on the Drawings unless noted otherwise.

B. Nosing shall be 3 inches wide and shall extend the full width of the stairway minus 3 inches on either side. Nosing shall be cast into the concrete and held in place with butterfly type extruded anchors.

C. The nosing shall be "Style 231-A", by Amstep Products, “Alumogrit Type 101", by Wooster Products, Inc., "Type AX", by Safe-T-Metal Company. For steel pan concrete filled stairs, nosing shall be "Type 101-SP", Wooster Products, Inc., or "Type AXPE", by Safe-T-Metal Company. For pan stairs, nosing shall be continuous over corner of stair treads to fully protect corner of treads from abrasion. All exposed fasteners shall be Type 304 stainless steel.

2.04 STAIR TREADS

A. Stair treads shall be aluminum with an abrasive nosing as shown on the Drawings.

B. Stair treads shall be designed for the live load specified in Section 05 51 00 – Metal Stairs.

C. Stair treads shall be as manufactured by IKG Industries, or Safe-T-Metal Company.

2.05 FRP STAIR NOSINGS

A. FRP stair nosings shall be provided on all concrete stairs in sodium hypochlorite areas and as indicated on the Drawings.

B. FRP stair nosings shall conform to Section 06 51 00 – Glass Fiber and Resin Fabrications as indicated on the Drawings.

2.06 FRP STAIR TREADS

A. FRP stair treads shall be provided for FRP stairs in sodium hypochlorite areas and as indicated on the Drawings.

B. FRP stair treads shall conform to Section 06 51 00 – Glass Fiber and Resin Fabrications.

PART 3 – EXECUTION

3.01 FABRICATION

A. All measurements and dimensions shall be based on field conditions and shall be verified by the Contractor prior to fabrication. Such verification shall include coordination with adjoining work.

B. All fabricated work shall be shop fitted together as much as practicable, and delivered to the field, complete and ready for erection. All miscellaneous items such as stiffeners, connections, brackets, and other details necessary for a complete installation shall be provided.

C. All work shall be fabricated and installed in a manner that will provide for expansion and contraction, prevent shearing of bolts, screws, and other fastenings, ensure rigidity, and provide a close fit of sections.

D. All shearings shall be neat and accurate, with parts exposed to view neatly finished. Flame cutting is allowed only when performed utilizing a machine.

E. All shop connections shall be welded unless otherwise indicated on the Drawings or specified herein. Bolts and welds shall conform to Section 05 05 23 – Metal Fastening. All fastenings shall be concealed where practicable.

3.02 INSTALLATION

A. Assembly and installation of stair treads and nosings shall be performed in strict accordance with manufacturer's recommendations.

B. All stair treads and nosings shall be erected square, plumb and true, accurately fitted, adequately anchored in place, and set at proper elevations and positions.

END OF SECTION

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SECTION 05 56 00
CASTINGS

PART 1 – GENERAL

1.01 REQUIREMENT

A. Furnish all materials, labor, and equipment required to provide all castings in accordance with the requirements of the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 33 05 61 – Utility Structures

B. Section 05 10 00 – Metal Materials

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.

1. Florida Building Code

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittal Procedures.

1. Complete fabrication and erection drawings of all castings specified herein.

2. Other submittals as required in accordance with Section 05 10 00 – Metal Materials and Section 05 05 23 – Metal Fastening.

PART 2 – PRODUCTS

2.01 METAL MATERIALS

A. Metal materials used for castings shall conform to Section 05 10 00 – Metal Materials, unless noted otherwise.

2.02 METAL FASTENING

A. All welds and fasteners used for castings shall conform to Section 05 05 23 – Metal Fastening, unless noted otherwise.

2.03 IRON CASTINGS

A. General - Iron Castings shall include, but not be limited to frames, covers, and grates for trench drains, catch basins, and inlets/.

1. Castings shall be of gray iron of uniform quality, free from defects, smooth and well cleaned by shotblasting.

2. Catalog numbers on the Drawings are provided only to show required types and configuration. All covers shall be cast with raised letters as designated on the Drawings.

3. Castings shall be as manufactured by Dewey Brothers, or Neenah Foundry Company.

B. Covers and Grates

1. Covers and grates shall be provided with matching frames. Cover shall fit flush with the surrounding finished surface. The cover shall not rock or rattle when loading is applied.

2. Round covers and frames shall have machined bearing surfaces.

3. Design loadings:

a. Where located within a structure, a minimum design loading of 300 psf shall be used, unless noted otherwise.

b. At all locations not within a structure, the design loading shall be a standard AASHTO H-20 truck loading, unless otherwise noted.

C. Watertight gasketing, bolting, locking devices, patterns, lettering, pickholes, vents, or self-sealing features shall be as detailed on the Drawings.

PART 3 – EXECUTION

3.01 FABRICATION

A. All measurements and dimensions shall be based on field conditions and shall be verified by the Contractor prior to fabrication. Such verification shall include coordination with adjoining work.

B. All fabricated work shall be shop fitted together as much as practicable, and delivered to the field, complete and ready for erection. All miscellaneous items such as stiffeners, fillets, connections, brackets, and other details necessary for a complete installation shall be provided.

C. Finished members shall conform to the lines, angles, and curves shown on the Drawings and shall be free from distortions of any kind.

3.02 INSTALLATION

A. Assembly and installation of fabricated system components shall be performed in strict accordance with manufacturer's recommendations.

B. All castings shall be erected square, plumb and true, accurately fitted, adequately anchored in place, and set at proper elevations and positions.

END OF SECTION

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SECTION 05 59 00
BEARING DEVICES AND ANCHORING

PART 1 – GENERAL

1.01 THE REQUIREMENTS

A. The Contractor shall furnish and install bearing plates, pads, expansion devices, anchor rods and bolts and/or other devices used in conjunction with bearings and anchoring of bearing devices and assemblies at supports in accordance with this item and in conformity with the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 05 10 00 – Metal Materials

B. Section 05 05 13 – Galvanizing

C. Section 05 05 23 – Metal Fastening

D. Section 05 12 00 – Structural Steel

E. Section 09 90 00 – Painting

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Without limiting the generality of other requirements of these Specifications, all work specified hereunder shall conform to the applicable requirements of the following documents to the extent that the provisions of such documents are not in conflict with the requirements of this Section.

1. RMA Rubber Handbook – A4-F3-T.063-B2, Grade 2, Method B

2. ASTM A240 – Standard Specification for Chromium and Chromium – Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and general Applications

3. ASTM A480 – Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip

4. ASTM D395 Method B – Standard Test for Rubber Property – Compression Set

5. ASTM D412 – Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension

6. ASTM D471 – Standard Test Method for Rubber Property – Effect of Liquids

7. ASTM D573 – Standard Test for Rubber-Deterioration in Air Oven

8. ASTM D575, Method A – Standard Test for Rubber Properties in Compression

9. ASTM D624, Die C – Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers

10. ASTM D746 – Standard Test for Brittleness Temperature of Plastics and Elastomers by Impact

11. ASTM D792 – Standard Test for Density and Specific Gravity of Plastics by Displacement

12. ASTM D1149 – Standard Test Methods for Rubber Deterioration in an Ozone Controlled Environment

13. ASTM D1785 – Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedule 40, 80, and 120

14. ASTM D2240 – Standard Test for Rubber Property – Durometer Hardness

15. ASTM D2256 – Standard Test Method for Tensile Properties of Yarns by the Single-Strand Method

16. ASTM D4894 – Standard Specification for PTFE Granular Molding and Ram Extrusion Materials

17. ASTM D4895 – Standard Specification for PTFE Resin Produced from Dispersion

1.04 SUBMITTALS

A. Submit the following in accordance with the requirements of Section 01 33 00 – Submittal Procedures:

1. Certification of compliance that the materials furnished under this section meet and conform to the property and physical requirements, including all testing, as stated herein and as referenced. Specifically, the certification shall state compliance with the applicable standards (ASTM, ANSI, etc.) for fabrication and testing.

2. Shop Drawings for all materials, including installation and adjustment instructions. Included with the Shop Drawings shall be all material certifications, mill test results, working drawings, etc., which are required by this and other applicable sections of the Specifications.

PART 2 – PRODUCTS

2.01 ELASTOMERIC BEARING PADS

A. The elastomer portion of pads shall be new neoprene compound. Pads shall be cast under heat and pressure and may be individually molded or cut from pressure-cast stock. Variations from the dimensions shown on the Drawings shall not be more than the following: thickness, ±1/16 inch; width, -1/8 to +1/4 inch; length, -1/8 to +1/4 inch. Tolerances, dimensions, finish and appearance, flash, and rubber-to-metal bonding shall conform to the requirements of A 4-F3-T.063-B2, Grade 2, Method B, in accordance with the RMA Rubber Handbook. Pads shall be furnished in one piece and shall not be laminated. Pads shall be furnished in identifiable packages.

B. Adhesive for use with elastomer pads shall be an epoxy-resin compound compatible with the elastomer having a sufficient shear strength to prevent slippage between pads and adjacent bearing surfaces. Adhesive shall be 20+F Contact Cement by Miracle Adhesives Corporation, Neoprene Adhesive 77-198 by IGI Adhesives, Sikadur 31, Hi-Mod Gel by Sika Corporation, or DP-605 NS Urethane Adhesive by 3M Adhesive Systems.

C. Material having a nominal Shore A durometer hardness of 70 shall be used for pads. Test samples will be prepared from finished pads. Samples of each thickness will be taken from 2 full-size pads from each shipment of 300 pads or less, with 1 additional pad for each additional increment of 300 pads or fraction thereof. When tested using the ASTM methods designated, samples shall comply with the following physical requirements.

1. Original Physical Properties: Test results for tear resistance, tensile strength, and ultimate elongation shall not be more than 10 percent below the following specified value:

	Nominal Hardness 70
Min. tear resistance, ASTM D624, Die C (lb/in of thickness)	200
Hardness, ASTM D2240 Shore A (points)	70±5
Min. tensile strength, ASTM D412 (average psi of longitudinal and transverse)	2,500
Min. ultimate elongation (%)	300

2. The compressive deflection tested in accordance with ASTM D575, Method A, shall be within 20 percent of that given in the charts of Method A, interpolating for actual measured hardness, when loaded within 300 to 800 pounds per square inch.

3. Changes in Original Physical Properties: When pads are oven aged 70 hours at 212°F in accordance with ASTM D573, changes shall not be more than the

following:

Property	Value
Hardness (points change)	0 to +15
Tensile strength (% change)	±15
Ultimate elongation (% change)	-40

4. Extreme Temperature Characteristics: Compression set under constant deflection, ASTM D395, Method B, 22 hours at 212°F, shall not be more than 35 percent. With the low-temperature brittleness test, ASTM D746, breaks shall not occur above –20°F.

5. Ozone Cracking Resistance: Upon exposure to 100 parts per million of ozone in air by volume at a strain of 20 percent and a temperature of 100±2°F in a test otherwise in accordance with ASTM D1149, cracks shall not develop within 100 hours. Samples shall be wiped with solvent before the test to remove traces of surface impurities.

6. Oil Swell: The volume change shall not be more than +120 percent when tested in accordance with ASTM D471 with ASTM Oil No. 3, 70 hours at 212°F.

2.02 TFE BEARING SURFACES

A. TFE resin shall be virgin material conforming to the requirements of ASTM D4894 or D4895. The specific gravity shall be 2.13 to 2.19. The melting point shall be 623±2°F.

B. Filler material shall be milled glass fibers, carbon, or other approved inert filler materials.

C. Adhesive material shall be an epoxy resin conforming to Federal Specification MMM-A-134, FEB film or equal, as approved by the Engineer.

D. When tested in accordance with ASTM D4894 or D4895, finished unfilled TFE sheets shall have a tensile strength of at least 2,800 pounds per square inch and an elongation of at least 200 percent.

E. Filled TFE sheets shall contain inert filler material uniformly blended with TFE resin. Finished filled TFE sheets containing glass fiber or carbon shall conform to the following:

	ASTM Method	15% Glass Fibers	25% Carbon
Min. tensile strength	D4894/D4895	2,000 psi	1,300 psi
Min. elongation	D4894/D4895	150%	75%
Min. specific gravity	D792	2.20	2.10

	ASTM Method	15% Glass Fibers	25% Carbon
Melting point	D4894/D4895	327±10°C	317 ±10°C

F. Fabric containing TFE fibers shall be manufactured from oriented multifilament TFE fluorocarbon fibers and other fibers as required by specific designs. When tested in accordance with ASTM D2256, the tensile strength of TFE fibers shall be at least 24,000 pounds per square inch and the elongation shall be at least 75 percent.

G. Where TFE sheets are to be epoxy bonded, one surface of the sheet shall be factory treated by an approved manufacturer using the sodium naphthalene or sodium ammonia process.

H. Stainless steel mating surfaces shall be at least 16 gage in thickness and shall conform to the requirements of ASTM A240, Type 304. The mating surface shall be a true plane surface with a Brinnell hardness of at least 125 and a surface finish of an at least No. 8 mirror finish in accordance with ASTM A480. Stainless steel mating surfaces shall be polished or rolled as necessary to conform to the friction requirements specified herein. The stainless steel shall be attached to the sole plate by means of a seal weld around the entire perimeter of the facing material.

I. The coefficient of friction for the completed bearing assembly shall not be more than the following:

Material	Bearing Pressure		
	500 psi (3.447 MPa)	2,000 psi (13.790 Mpa)	3,500 psi (24.132 MPa)
Unfilled TFE, fabric Containing TFE fibers, TFE perforated metal composite	.08	.06	.04
Filled TFE	.12	.10	.08
Interlocked bronze and filled TFE structures	.10	.07	.05

2.03 ANCHOR RODS

A. Anchor bolts shall be as specified in Section 05 05 23 – Metal Fastening.

PART 3 – EXECUTION

3.01 STEEL PLATES, SHAPES, AND BARS

A. Unless galvanizing is indicated on the Drawings, items shall be painted in accordance with the Drawings and Section 09 90 00 – Painting.

B. If galvanizing is indicated on the Drawings, steel bearing assemblies for both structural steel beams and girders and prestressed concrete members shall be galvanized as specified in Section 05 05 13 – Galvanizing. Except for attachments of bearing plates to beams, all fabrication and welding of bearing plate assemblies shall be performed before the steel is galvanized. All joints of welded parts shall be sealed with weld material. Welds made for attaching bearing plates to beams or girders shall be cleaned and given 2 coats of zinc rich paint having a minimum total coating thickness of 3 mils.

3.02 BRONZE PLATES

A. Sliding surfaces of bronze plates shall be polished.

3.03 COPPER-ALLOY PLATES

A. Finishing of rolled copper-alloy plates will not be required provided their surfaces are plane, true, and smooth.

3.04 SELF-LUBRICATING PLATES

A. Plates shall be fabricated from cast bronze or rolled copper alloy.

B. Sliding surfaces of plates shall be provided with annular grooves or cylindrical recesses or a combination thereof, which shall be filled with a lubricating compound. The lubricating compound shall be compressed into recesses under sufficient pressure to form a non-plastic lubricating inset. The inset shall comprise at least 25 percent of the total area of the plate. The frictional coefficient shall not be more than 0.10. The compound shall be free from material that will cause abrasive or corrosive action on metal surfaces and able to withstand extremely high pressures and atmospheric elements over long periods of time.

C. Items shall be the standard products of the manufacturer of such materials for the application.

D. Prior to assembly, the steel surface that will bear on the self-lubricating bearing plate shall be thoroughly lubricated with additional antioxidant lubricant furnished by the manufacturer. Coatings shall be removed before application of antioxidant lubricant.

3.05 ELASTOMERIC PADS

A. Care shall be taken in fabricating pads and related metal parts so that effects detrimental to their proper performance, such as uneven bearing and excessive bulging, will not occur.

3.06 PLACEMENT OF BEARING PLATES AND PADS

A. Bearing areas shall be finished to a true level plane which shall not vary perceptibly from a straightedge placed in any direction across the area.

B. Bearing plates or pads shall be set level in exact position and shall have a uniform bearing over the entire area. Provision shall be made to keep plates or pads in the correct position during erection of beams or placement of concrete.

C. Elastomeric pads and other flexible bearing materials shall be placed directly on masonry surfaces finished to a roughness equivalent to that of a No. 36 to No. 46 grit. Pads, bearing areas, and metal bearing plates shall be thoroughly cleaned and free from oil, grease, and other foreign materials. Metal bearing plates or bottoms of prefabricated beams that are to bear on elastomeric pads shall be coated with epoxy and then surfaced with a No. 36 to No. 46 silicon carbide or aluminum oxide grit. Bearing areas shall be finished to equivalent roughness.

3.07 PLACEMENT OF ANCHOR RODS

A. All necessary anchor rods and bolts (anchors) shall be accurately set either in the concrete as they are being placed, in formed holes, or in holes cored after the concrete has set. If set in the concrete, the rods and bolts shall be accurately positioned by means of templates and rigidly held in position while the concrete is being placed. Holes may be formed by inserting or casting in the fresh concrete oiled wooden plugs, metal pipe or plastic sleeves, or other approved devices, and withdrawing them after the concrete has partially set or left in place as indicated on the Drawing's or approved by the Engineer. Holes so formed shall be at least 3 inches in diameter or at least 2.5 times the diameter of the rod or bolt. If cored, holes shall be at least 2.5 times the diameter of the anchor used or as indicated on the Drawings. Equipment used for coring concrete shall have been approved by the Engineer. Impact tools will not be permitted. Reinforcing steel shall be placed to provide adequate space to core rod/bolt holes without cutting the reinforcing steel. For cored holes, anchor rods and bolts shall be adequately held in place at the centroid of the hole or as specified on the Drawings by using approved pre-fabricated equalizers designed to allow grout to penetrate and fill the hole completely and spaced as approved by the Engineer.

B. During freezing conditions, anchor holes shall be protected from water accumulation.

C. Anchors which are to be placed in holes of sufficient and specified diameter after the concrete has set shall be bonded to the concrete with a non-shrink high-strength Portland cement grout in accordance with Section 03 60 00 – Grout or shall be adhesive anchors in accordance with Section 05 05 23 – Metal Fastening. The type anchoring system and grout shall be as indicated on the Drawings. The grout or adhesive shall completely fill the holes. Anchors shall be tested for sufficient pull-out capacity as indicated in applicable sections of the Specifications or as indicated on the Drawings.

D. Anchors that are not designed to project through bearing plates shall be checked for proper projection above the masonry bearing area immediately prior to placement of bearing plates and beams. Nuts on anchor rods at expansion ends shall be adjusted to permit free movement of the span.

E. Angles for anchor assemblies to be attached to sides of concrete beams shall not be installed until beams have received their full dead load and supporting falsework has been removed.

END OF SECTION

DIVISION 06 – WOOD, PLASTICS, AND COMPOSITES

SECTION 06 51 00
GLASS FIBER AND RESIN FABRICATIONS

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish and install all fiberglass items as specified herein and as shown on the Drawings. The Contractor shall be responsible for the coordination with related work specified elsewhere and to provide all hardware, accessories and appurtenances required for a complete installation, including all fabrication and mounting hardware.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 05 05 23 – Metal Fastening

B. Section 09 90 00 – Painting

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.

1. ASTM D635 – Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position

2. ASTM D3647 – Standard Practice for Classifying Reinforced Plastic Pultruded Shapes According to Composition

3. ASTM D3917 – Standard Specification for Dimensional Tolerances of Thermosetting Glass - Reinforced Plastic Pultruded Shapes

4. ASTM D4385 – Standard Practice for Classifying Visual Defects in Thermosetting Reinforced Plastic Pultruded Products

5. ASTM E84 – Standard Test Method for Determining Surface Burning Characteristics for Building Materials

1.04 SUBMITTALS

A. The Contractor shall submit shop drawings showing fabrication details and a Performance Affidavit for all items specified herein in accordance with Section 01 33 00 – Submittal Procedures and Section 46 00 00 – Equipment General Provisions.

B. Certification of compliance with ASTM Standards.

C. Where specifically requested, design drawings and calculations sealed by a currently Registered Professional Engineer in the State or Commonwealth in which the project is located. FRP grating floor system and guard and handrail systems will require these sealed items.

1.05 QUALITY ASSURANCE

A. All fiberglass items of the same type provided shall be the products of a single manufacturer for compatibility.

B. The Contractor is responsible for ensuring that the fiberglass items and appurtenances furnished shall be compatible and have the necessary operating clearances with the structural elements and equipment shown on the Drawings.

C. Manufacturer shall provide a 3-year warranty on all FRP products against defect in material and workmanship.

PART 2 – MATERIALS

2.01 GENERAL

A. All manufacturing shall occur in the United States. The manufacturer shall maintain a continuous quality control program and shall, upon request, furnish the Engineer with certified test reports consisting of physical tests of samples.

B. Ultraviolet light resistive resins shall be used for all exterior locations and where specified.

C. All FRP resins shall be flame resistant and shall meet the requirements of ASTM D 635 and ASTM E 84, Class 1 with a maximum flame spread rating of 25.

D. All edges shall be sealed in the mold where possible. Machined or cut edges shall be sealed with a compatible resin system.

2.02 GRATING AND TREADS

A. Fiberglass grating and treads shall be furnished and installed in areas shown on the Drawings including all FRP angle supports, fasteners and accessories. Gratings and treads shall consist of extruded bearing bars positioned and locked by crossbars. Grating and treads shall be installed in accordance with the manufacturer's recommendations.

B. Grating shall be fabricated into easily removable sections as large as possible up to 150 lbs. per section.

C. Fasteners shall not project above the walking surface.

D. Fiberglass grating and treads shall be manufactured vinyl ester fire retardant (VEFR) resin. Grating and treads shall be produced by IKG Industries, Fibergrate, Inc., American Grating with Bedford Plastics, Strongwell, or equal.

E. Grating shall be designed for a uniform loading of 100 PSF over the gross projected area with deflection limited to 0.375” or grating span/240 whichever is less. Fiberglass or PVC support beams shall be provided as required to meet deflection criteria.

F. The grating and tread supplier shall supply all shelf support angles, embedded angles with anchors, concrete anchors and necessary 316 stainless steel grating clips.

G. Treads shall be designed for a 300 lb. concentrated load at midspan. Treads shall be furnished with integral nosing.

2.03 FIXED LADDERS

A. The Contractor shall provide fixed ladder systems with all safety cages, landings, mounting clips, fasteners, and necessary appurtenances for a complete and rigid installation.

B. The ladder systems shall be designed to meet or exceed all OSHA requirements.

C. Ladders shall be fabricated from pultruded shapes conforming to VEFR. Shapes shall be manufactured by Strongwell, Inc., Fibergrate Composite Structures, or equal.

D. Ladder side rails shall be fabricated from channel members or 1-3/4 inch minimum square tube.

E. Side rails shall be anchored with FRP standoff clips manufactured of VEFR. Clips shall be placed at the top and bottom of the ladder and at 6-foot maximum vertical centers.

F. Rungs

1. Rungs shall be 18 inches long, 1-1/4” fluted tubes for non-skid surfaces or serrated and covered with a silica grit to produce an anti-skid surface.

2. Rungs shall be uniformly spaced at 12 inches on center.

3. Rungs shall be designed to support a 1,200-pound vertical load applied at midspan.

4. Rungs shall be both mechanically attached, and epoxy bonded to the side rails.

G. Ladder safety system shall be as specified in Section 05 51 33 – Ladders.

2.04 CONNECTIONS

A. All connections shall be non-corrosive, non-staining, and concealed where practical, as detailed on the Drawings or specified herein.

B. Fiberglass fasteners shall be "Fibrebolt", as manufactured by Strongwell, Inc., or equal.

C. All metal fasteners shall be Type 316 stainless steel, except where Hastelloy C-276 or fiberglass fasteners are specifically required on the Contract Drawings.

D. Holes for bolts and screws shall be drilled.

E. Joints exposed to weather shall be formed to exclude water.

F. Design and installation of fiberglass items shall provide for expansion and contraction, prevent shearing of bolts, screws, and other fastenings, and provide close fitting of sections.

2.05 STRUCTURAL SHAPES AND FLAT SHEETS

A. Shapes shall conform to sizes indicated on Drawings and shall be ISOFR except where VEFR is specifically required on the Contract Drawings. Shapes shall be manufactured by Strongwell, Inc., Fibergrate Composite Structures, or equal.

B. Metal bolted connections shall be made with stainless steel bolts except where Hastelloy C bolts or fiberglass fasteners are specifically required on the Contract Drawings. Bolts shall conform to Section 05 05 23 – Metal Fastening.

C. Adhesive bonded connections shall be made with a compatible epoxy adhesive following manufacturer's instructions. Adhesive bonded connections shall only be used where bolted connections are not feasible.

2.06 FRP GUARDS (NOT USED)

PART 3 – EXECUTION

3.01 FABRICATION

A. All cut edges and holes shall be sealed with a compatible resin.

B. All FRP items shall conform to the dimensions indicated on the Drawings.

C. All fiberglass items described in this Section shall be supplied by a manufacturer that normally fabricates such items so that appearance and quality control are acceptable.

3.02 HANDLING, TRANSPORTING, AND STORING

A. All FRP items shall be properly packed, labeled and stored in accordance with Specifications and as directed by the Engineer.

3.03 INSTALLATION

A. Installation of all items shall be according to manufacturer's instructions, unless otherwise noted.

B. Exposed threads of FRP bolts shall be sealed with a compatible resin after installation of the bolts. Where bolts are attaching removable items, the exposed threads shall be sealed with a light coat of polyurethane sprayed onto the threads.

END OF SECTION

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DIVISION 07 – THERMAL AND MOISTURE PROTECTION

SECTION 07 90 00

JOINT FILLERS, SEALANTS AND CAULKING

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. Furnish labor, materials, equipment and appliances required for the complete execution of Work shown on the Drawings and specified herein.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 03 15 00 – Concrete Accessories

B. Section 03 15 16 – Joints in Concrete

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.

1. ASTM C-920 – Elastomeric Joint Sealants

2. ASTM D-1056 – Flexible Cellular Materials – Sponge or Expanded Rubber

3. SWRI – Sealant and Caulking Guide Specification

1.04 SUBMITTALS

A. In accordance with the procedures and requirements set forth in Section 01 33 00 – Submittal Procedures, submit the following:

1. Manufacturers literature and installation instructions. Label each product submitted with Type as indicated in paragraph 2.01 A.

2. Color samples of each type of sealant.

1.05 QUALITY ASSURANCE

A. Applicator shall be a company specializing in the installation of sealants with a minimum of five years of experience.

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver materials in unopened labeled packages.

B. Store materials in location protected from freezing or damages.

C. Reject and remove from the site materials within broken or damaged packaging.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Sealants

1. Type 1: Multi-component, non-sag, low-modulus polyurethane rubber sealant meeting ASTM C-920, Type M, Grade NS, Class 25, use NT, M, A, and O. Capable of withstanding 25% in extension or compression such as Sikaflex-2C NS/SL, Sika Corporation, or Sonolastic NP-2, Sonneborn, or DynaTrol II by Pecora Corporation.

2. Type 2: Single component polyurethane sealant meeting ASTM C-920, Type S, Grade NS, Class 25, Use NT, M, A, and O. Capable of withstanding 25% in extension or compression such as Sikaflex 1A by Sika Corporation, DynaTrol 1-XL by Pecora Corporation, or Sonolastic NP-1 by Master Builders Solutions.

3. Type 3: Single component, low-modulus moisture curing silicone meeting ASTM C920, Type S, Grade NS, Class 50, Use NT, M, G, and A. Capable of withstanding 50% extension and compression. Pecora 890 by Pecora Corporation, Sonolastic Omni Seal by Master Builders Solutions.

4. Type 4: Single component, mildew resistant, moisture-curing silicone meeting ASTM C-920, Type S, Grade NS, Class 25, Use NT, M, G, and A. Pecora 898 by Pecora Corporation, Sonolastic Omni Plus by Master Builders Solutions.

5. Type 5: Single component, acrylic latex meeting ASTM C-834. AC-20+ Silicone by Pecora Corporation, Sonneborn Sonolac by Master Builders Solutions.

6. Type 6: High grade butyl sealant meeting Federal Specification TT-S-00-1657. BC-158 by Pecora Corporation or equal.

7. Type 7: Multi-component chemical resistant polysulfide sealant conforming to ASTM C-920, Type M, Grade NS, Class 25 such as Deck-O-Seal by W.R. Meadows, Tammsflex by DuraJoint Concrete Accessories, or Synthacalk GC2+ by Pecora Corporation.

8. Type 8: Nonsag, Multi Component, traffic grade polyurethane sealant meeting ASTM C920, Type M, Grade NS, Class 25, use T, M, A, and O. DynaTread by Pecora Corporation, MasterSeal CR 195 by Master Builders Solutions.

B. Primer: Non-staining primer recommended by sealant manufacturer for the substrates on this project.

C. Backer Rod: Closed cell foam, nonreactive with caulking materials, non-oily, and approved by the sealant manufacturer. Minimum density shall be 2.00 pounds per cubic foot. Use no asphalt or bitumen-impregnated fiber with sealants.

D. Joint Cleaner: Recommended by sealant or caulking compound manufacturer.

E. Bond breaker: Either polyethylene film or plastic tape as recommended by the sealant manufacturer.

F. Color: Where manufacturer's standard colors do not closely match materials being sealed, provide a custom color.

PART 3 – EXECUTION

3.01 QUALITY CONTROL

A. Coordinate work with details shown on approved shop drawings prepared by other trades.

B. Verify conditions in the field.

C. Schedule work to follow closely the installation of other trades.

D. Apply sealants and related items in temperatures and dry conditions recommended by the manufacturers.

E. Do not paint sealant, unless recommended by sealant and paint manufacturer.

3.02 PREPARATION

A. Protect finished surfaces adjoining by using masking tape or other suitable materials.

B. Clean and prime joints before starting any caulking or sealing work.

C. Thoroughly clean joints and spaces of mortar and other foreign materials. Cleaning agent shall be Xylol or similar non-contaminating solvent to remove any film from metal surfaces. Masonry or concrete surfaces shall be brushed or air jet cleaned.

D. Joint Requirements

1. All joints and spaces to be sealed in exterior work shall be less than ½-inch deep and not less than 1/4 inch wide. If joints in masonry are less than that specified herein, the mortar shall be cut out to the required width and depth. All joints and spaces to receive sealant shall be completely prepared and thoroughly dry before installation of sealant.

2. Unless otherwise specified, joints and spaces which are open to a depth of 1/2 inch or greater shall be solidly filled with back-up material to within 1/4 inch of the surface. Back-up material shall be packed tightly and made continuous throughout the length of the joints. Bond breaker shall be applied as required. If joints are less than ¼-inch deep, the back-up material may be omitted, a bond breaker substituted and the joint completely filled with sealant. The back-up material shall not project beyond the ¼-inch depth of the open space in any joint. The following width-to-depth ratio table shall be adhered to, unless otherwise recommended by manufacturer.

	Sealant Depth	
Joint Width	**Minimum**	**Maximum**
¼ inch	1/4 inch	1/4 inch
Over 1/4 inch to 1/2 inch	1/4 inch	Equal to width
Over 1/2 inch to 1 inch	1/2 inch	Equal to width
Over 1 inch to 2 inches	1/2 inch	1/2 of width

3.03 APPLICATION

A. Exercise care before, during, and after installation so as not to damage any material by tearing or puncturing. All finished work shall be approved before covering with any other material or construction.

B. Apply sealant by an approved type of gun except where the use of a gun is not practicable, suitable hand tools shall be used. Avoid applying the compound to any surface outside of the joints or spaces to be sealed. Mask areas where required to prevent overlapping of sealant.

C. All joints shall be waterproof and weathertight.

D. Point sealed joints to make a slightly concave joint, the edges of which are flush with the surrounding surfaces. Exposed joints in the interior side of the door and other frames shall be neatly pointed flush or to match adjacent jointing work.

E. Adjacent materials which have been soiled shall be cleaned immediately and the work left in neat and clean condition.

F. Comply with sealant manufacturer's written instructions except where more stringent requirements are shown or specified and except where manufacturer's technical representative directs otherwise.

3.04 ADJUSTMENT AND CLEANING

A. Remove misplaced sealant compounds promptly using methods and materials recommended by the manufacturer, as the work progresses.

B. Allow sealants to cure and remove protective edging, of doors, louvers, saddles windows etc. as directed by the Engineer.

3.05 SCHEDULE

Schedule of Sealants

Application	Sealant	Color
Vertical and horizontal expansion and construction joints in concrete structures unless noted otherwise herein or on Drawings.	Type 1	To closely match adjacent surfaces or mortar and as selected by the Owner.
Vertical and horizontal joints bordered on both sides by masonry, precast concrete, natural stone or other porous building material, unless noted otherwise herein or on Drawings.	Type 2	To closely match adjacent surfaces or mortar and as selected by the Owner.
Vertical and horizontal joints bordered on both sides by painted metals, anodized aluminum, mill finished aluminum, PVC, glass or other non-porous building material.	Type 3	To closely match adjacent surfaces and as selected by the Owner.
Masonry expansion and control joints less than 1¼" wide.	Type 2	To closely match adjacent surfaces and as selected by the Owner.
Masonry expansion and control joints equal or greater than 1¼ inches wide and not to exceed 2”.	Type 1	To closely match adjacent surfaces and as selected by the Owner.
Interior – wood trim and finish joints.	Type 5	Color to be selected by Owner
Sanitary areas, joints in ceramic tile, around plumbing fixtures, countertops, and back splashes.[1]	Type 4	To closely match adjacent surfaces and as selected by the Owner.
Perimeter sealing of doors, windows, louvers, piping, ducts, and electrical conduit.[2]	Type 2 OR Type 3	To closely match adjacent surfaces and as selected by the Owner.
Below thresholds.	Type 6	Manufacturer's standard
Submerged in liquids.[3,4]	Type 1	Manufacturer's standard
Submerged in liquids with high concentration of chlorine (> 2 ppm)	Type 7	Manufacturer’s standard
Horizontal Joints exposed to vehicular or pedestrian traffic.	Type 8	To closely match adjacent surfaces.

Schedule of Sealants

Application	Sealant	Color
Other joints indicated on the drawings or customarily sealed but not listed.	Type recommended by manufacturer	To closely match adjacent surfaces and as selected by the Owner.

[1] Sealant for Laboratory Countertop shall be as recommended by countertop manufacturer.
[2] Provide UL approved sealants for penetrations thru fire-rated walls and as specified in Section 07 84 00 - Firestopping.
[3] Sealants which will come in contact with potable water shall meet the requirements of NSF 61.
[4] Where sealant will be immersed in liquid chemicals verify compatibility prior to installation of sealant.

END OF SECTION

DIVISION 09 – FINISHES

SECTION 09 90 00

PAINTING

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. Furnish labor, materials, equipment and appliances required for complete execution of Work shown on Drawings and Specified herein.

B. Section Includes:

1. Paint Materials
2. Shop Painting
3. Field Painting
    a. Surface Preparation
    b. Piping and Equipment Identification
    c. Schedule of Colors
    d. Work in Confined Spaces
    e. OSHA Safety Colors

1.02 RELATED SECTIONS

A. Section 40 05 97 – Piping and Equipment Identification Systems

B. Section 07 90 00 – Joint Fillers, Sealants, and Caulking

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of these specifications, the Work shall conform to the applicable requirements of the following documents:

1. SSPC – The Society for Protective Coatings Standards
    a. SSPC-Vis 1 – Pictorial Surface Preparation Standards for Painting Steel Structures
    b. SSPC-SP2 – Hand Tool Cleaning
    c. SSPC-SP3 – Power Tool Cleaning

d. SSPC-SP5/NACE 1 – White Metal Blast Cleaning

e. SSPC-SP6/NACE 3 – Commercial Blast Cleaning

f. SSPC-SP7/NACE 4 – Brush-off Blast Cleaning

g. SSPC-SP10/NACE 2 – Near-White Metal Blast

h. SSPC-SP11 – Power Tool Cleaning to Bare Metal

i. SSPC-SP13/NACE6 – Surface Preparation of Concrete

2. ICRI – International Concrete Repair Institute

3. NACE – National Association of Corrosion Engineers

4. NAFP – The National Association of Pipe Fabricators

5. ASTM D1737 – Test Method for Elongation of Attached Organic Coatings with Cylindrical Mandrel Apparatus

6. ASTM B117 – Method of Salt Spray (Fog) Testing

7. ASTM D4060 – Test Method for Abrasion Resistance of Organic Coating by the Taber Abraser

8. ASTM D3359 – Method for Measuring Adhesion by Tape Test

1.04 SUBMITTALS

A. In accordance with the procedures and requirements set forth in Section 01 33 00 – Submittal Procedures, submit the following:

1. Manufacturer's literature and Material Safety Data Sheets for each product.

2. Samples of each finish and color. Submitted samples of each finish and color shall be prepared in a step-down format so that the area of each sample indicates the appearance of the various coats. For example, where a three-coat system is specified, the sample shall be divided into three areas indicating one coat only, two coats and all three coats. The Engineer will provide written authorization constituting a standard, as to color and finish only, for each coating system.

3. Painting schedule identifying surface preparation and paint systems proposed. Cross reference with Tables 1 and 2. Provide the name of the paint manufacturer, and name, address, and telephone number of manufacturer's representative who will inspect the work. Submit schedule for approval as soon as possible following the Award of Contract, so approved schedule may be used to identify colors and

specify shop paint systems for fabricated items. Manufacturer shall substitute paint system with equal performance where required for VOC compliance.

4. Contractor shall submit Q.C. Inspection plan describing all tests and inspections task to be performed. Include copy of daily log showing environmental conditions measurements and frequency. Copy of completed log shall be provided at completion of work.

5. Name and detailed qualifications of the protective coating applicator or subcontractor. Qualifications shall include, but not be limited to, five (5) project references which show that the painting applicator or subcontractor has previous successful experience with the specified or comparable coating systems, a list of installations that are currently in service and documentation that applicator or subcontractor is currently a qualified applicator of the proposed coatings by the manufacturer. Include the name, address and telephone number of the owner of each installation for which the coating applicator provided the coating.

6. CERTIFICATIONS: The coating manufacturer shall submit the following certifications:

   a. A letter from the coating manufacturer stating that the specified material is suitable for the application.

   b. Inspection reports of coating manufacturer certifying that all inspections by the manufacturer as specified in 09 90 00-1.09(B) showed satisfactory performance of the work by the coating applicator.

   c. A letter from the coating manufacturer certifying that the surface preparation has been properly completed.

   d. A letter from the coating manufacturer certifying that the coating system has been properly applied and acknowledging that their warranty is in effect.

   e. A sample copy of the warranty to be issued after completion of the work.

7. Test reports of all testing and inspections during the work

1.05 SYSTEM DESCRIPTION

A. Work shall include surface preparation, paint application, inspection of painted surfaces and corrective action required, protection of adjacent surfaces, cleanup and appurtenant work required for the proper painting of all surfaces to be painted. Surfaces to be painted are designated within the Painting Schedule and may include new and existing piping, miscellaneous metals, equipment, buildings, exterior fiberglass, exposed electrical conduit and appurtenances.

B. Perform Work in strict accordance with manufacturer's published recommendations and instructions, unless the Engineer stipulates that deviations will be for the benefit of the project.

C. Paint surfaces which are customarily painted, whether indicated to be painted or not, with painting system applied to similar surfaces, areas and environments, and as approved by Engineer.

D. Submerged ferrous metal, piping, and internal pump surfaces within potable water facilities or potable water distribution systems shall be painted with NSF 61/600 approved coatings.

E. Piping and equipment shall receive color coding and identification. Equipment shall be the same color as the piping system.

1.06 QUALITY ASSURANCE

A. Painting operations shall be accomplished by skilled craftsman and licensed by the state of Florida.

B. Provide a letter indicating that the painting applicator has five years of experience, and 5 references which show previously successful application of the specified or comparable painting systems. Include the name, address, and the telephone number for the Owner of each installation for which the painting applicator provided services.

C. Contractor shall coordinate Q.C Inspections.

D. The Contractor shall give the Engineer a minimum of three days advance notice of the start of any field surface preparation work of coating application work.

E. All such Work shall be performed only in the presence of the Engineer, unless the Engineer has specifically allowed the performance of such Work in his absence

F. Notify Owner and Engineer at completion of surface preparation, priming application and final cure to allow inspection by Owner and Engineer or their Third-Party Inspector.

G. Review by the Engineer, or the waiver of review of any particular portion of the Work, shall not relieve the Contractor of his responsibility to perform the Work in accordance with these Specifications.

1.07 STORAGE AND DELIVERY

A. Bring materials to the job site in the original sealed and labeled containers.

B. Container label to include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

C. Store paint materials at minimum ambient temperature of 45 degrees F (7 degrees C) and a maximum of 90 degrees F (32 degrees C), in ventilated area, and as required by manufacturer's instructions.

1.08 SAFETY AND HEALTH REQUIREMENTS

A. Require that personnel perform work in strict accordance with the latest requirements of OSHA Safety and Health Standards for construction. Meet or exceed requirements of regulatory agencies having jurisdiction and the manufacturer's published instructions and recommendations. Maintain a copy of all Material Safety Data Sheets at the job site of each product being used prior to commencement of work. Provide and require that personnel use protective and safety equipment in or about the project site. Provide respiratory devices, eye and face protection, ventilation, ear protection, illumination and other safety devices required to provide a safe work environment.

B. Respirators shall be worn by persons engaged or assisting in spray painting. The CONTRACTOR shall provide ventilating equipment and all necessary safety equipment for the protection of the workmen and the work.

C. All paint shall comply with all requirements of the Air Pollution Regulatory Acts concerning the application and formulation of paints and coatings for an area in which the paints are applied. Specifically, paints shall be reformulated as required to meet the local, State and Federal requirements.

1.09 SERVICES OF MANUFACTURER’S REPRESENTATIVE

A. The Contractor shall purchase paint from an acceptable manufacturer. The manufacturer shall assign a representative to inspect the application of his product both in the shop and field. The Contractor, through the manufacturer's representative, shall submit his report to the Engineer at the completion of his Work identifying the products used and verifying that said products were properly applied and that the paint systems were proper for the exposure and service.

B. Services shall also include, but not be limited to, inspecting prior coatings of paint, determination of best means of surface preparation, inspection of complete work, and re-inspection of painted work to be performed six months after the job is completed.

1.10 MANUFACTURER’S INSTRUCTIONS

A. The manufacturer's published instructions for use as a guide in specifying and applying the manufacturers proposed paint shall be submitted to the Engineer. Paint shall not be delivered to the job before acceptance of the manufacturer's instructions is given by the Engineer.

B. A manufacturer's paint will not be considered for use unless that manufacturer's published instructions meets the following requirements:

1. The instructions must have been written and published by the manufacturer for the purpose and with the intent of giving complete instruction for the use and application of the proposed paint in the locality and for the conditions for which the paint is specified or shown to be applied under this Contract.

2. All limitations, precautions, and requirements that may adversely affect the paint; that may cause unsatisfactory results after the painting application; or that may cause the paint not to serve the purpose for which it was intended; that is, to protect the covered material from corrosion, shall be clearly and completely stated in the instructions. These limitations and requirements shall, if they exist, include, but not be limited to the following:

    a. Methods of application

    b. Number of coats

    c. Thickness of each coat

    d. Total thickness

    e. Drying time of each coat, including primer

    f. Primer required to be used

    g. Primers not permitted

    h. Use of a primer

    i. Thinner and use of thinner

    j. Temperature and relative humidity limitations during application and after application

    k. Time allowed between coats

    l. Protection from sun

    m. Physical properties of paint including solids content and ingredient analysis

    n. Surface preparation

    o. Touch up requirements and limitations

C. Concrete surfaces specified by the paint manufacturer to be acid etched shall be etched in accordance with the manufacturer's instructions. The surface shall then be thoroughly scrubbed with clean water, rinsed, and allowed to dry. The surface shall be tested with a moisture meter to determine when dry before coating. The surface shall also be tested for pH to determine the acid has been properly neutralized.

1.11 SURFACES NOT TO BE COATED

A. The following items shall not be coated unless otherwise noted:

1. Encased piping or conduit.

2. Stainless steel work.

3. Clear PVC secondary containment piping.

4. Galvanized checkered plate.

5. Aluminum handrails, walkways, windows, louvers, grating and checkered plate.

6. Flexible couplings, lubricated bearing surfaces and insulation.

7. Packing glands and other adjustable parts of mechanical equipment.

8. Finish hardware.

9. Steel encased in concrete or masonry

10. Plastic switch plates and receptacle plates.

11. Signs and nameplates.

12. Any code-required labels, such as Underwriters' Laboratories and Factory Mutual, or any equipment identification, performance rating, name or nomenclature plates.

13. Any moving parts of operating units, mechanical and electrical parts, such as valve and damper operators, linkages, sensing devices, motor and fan shafts, unless otherwise indicated

1.12 QUALITY WORKMANSHIP

A. The Contractor shall be responsible for the cleanliness of his painting operations and shall use covers and masking tape to protect work whenever such covering is necessary, or if so requested by the Owner. Any unwanted paint shall be carefully removed without damage to any finished paint or surface. If damage occurs, the entire surface, adjacent to and including the damaged area, shall be repainted without visible lap marks and without additional cost to the Owner.

B. Painting found defective shall be scraped or sandblasted off and repainted as the Owner may direct. Before final acceptance of the work, damaged surfaces of paint shall be cleaned and repainted as directed by the Owner.

1.13 ADDITIONAL PAINT

A. At the end of the project, the Contractor shall turn over to the Owner a one gallon can (single component material) or small kit (multi component material – minimum of one gallon yield) of each type and color of paint, primer, thinner or other coating used in the field painting. The material shall be delivered in unopened, labeled cans as it comes from the factory. The manufacturer's literature describing the materials and giving directions for their use shall be furnished in three bound copies. A type-written inventory list shall be furnished at the time of delivery.

1.14 WARRANTY

A. The coating manufacturer shall provide a standard material product warranty for a period of 5 years from the date of substantial completion

PART 2 – MATERIALS

2.01 GENERAL INFORMATION

A. The term "paint" is defined as both paints and coatings including emulsions, enamels, stains, varnishes, sealers, and other coatings whether organic or inorganic and whether used as prime, intermediate, or finish coats.

B. Purchase paint from an approved manufacturer. Manufacturer shall assign a representative to inspect application of their product both in the shop and field. The manufacturer's representative shall submit a report to the Engineer at the completion the Work identifying products used and verifying that surfaces were properly prepared, products were properly applied, and the paint systems were proper for the exposure and service.

C. Provide primers and intermediate coats produced by same manufacturer as finish coat. Use only thinners approved by paint manufacturer, and only within manufacturer's recommended limits.

D. Ensure compatibility of total paint system for each substrate. Test shop primed equipment delivered to the site for compatibility with final paint system. Provide an acceptable barrier coat or totally remove shop applied paint system when incompatible with system specified, and repaint with specified paint system.

E. Use painting materials suitable for the intended use and recommended by paint manufacturer for the intended use.

F. Require that personnel perform work in strict accordance with the latest requirements of OSHA Safety and Health Standards for construction. Meet or exceed requirements of regulatory agencies having jurisdiction and the manufacturer's published instructions and recommendations. Maintain a copy of all Material Safety Data Sheets at the job site of

each product being used prior to commencement of work. Provide and require that personnel use protective and safety equipment in or about the project site. Provide respiratory devices, eye and face protection, ventilation, ear protection, illumination and other safety devices required to provide a safe work environment.

G. All building, facilities, structures, and appurtenances, as indicated on the Drawings and as specified herein, shall be painted with not less then one shop coat and two field coats, or one prime coat and two finish coats of the appropriate paint. Items to be painted include, but are not limited to, exterior and interior concrete, structural steel, miscellaneous metals, steel and aluminum doors and frames, concrete block, ductwork, sluice gates, operators, pipe fittings, valves, mechanical equipment, motors, conduit, and all other work which is obviously required to be painted unless otherwise specified.

H. Baked-on enamel finishes and items with standard shop finishes such as graphic panels, electrical equipment, toilet partitions, lockers, instrumentation, etc., shall not be field painted unless the finish is damaged during shipment or installation. Aluminum, stainless steel, fiberglass and bronze work shall not be painted unless color coding and marking is required or otherwise specified.

2.02 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Specifications, provide products from one of the following manufacturers:

1. Tnemec Company Inc.
2. PPG
3. CARBOLINE
4. Sherwin-Williams
5. International Paints (Akzo Nobel)

PART 3 – EXECUTION

3.01 SHOP PAINTING

A. Shop prime fabricated steel and equipment with at least one shop coat of prime paint compatible with finish paint system specified. Prepare surface to be shop painted in strict accordance with paint manufacturer's recommendations and as specified. Finish coats may be shop applied, if approved by the Engineer. Package, store and protect shop painted items until they are incorporated into Work. Repair painted surfaces damaged during handling, transporting, storage, or installation to provide a painting system equal to the original painting received at the shop.

B. Identify surface preparation and shop paints on Shop Drawings. Verify compatibility with field applied paints.

C. Coordinate shop painting and field coating to ensure item is delivered and field coating occurs within recoat window of shop painted system requirements.

D. Shop finish coats may be the standard finish as ordinarily applied by the manufacturer if it can be demonstrated to the Engineer that the paint system is equal to and compatible with the paint system specified. However, all pumps, motors and other equipment shall receive at least one field applied finish coat after installation.

3.02 SURFACE PREPARATION

A. General

1. Surfaces to be painted shall be clean and dry, and free of dust, rust, scale, and foreign matter. No solvent cleaning, power or hand tool cleaning shall be permitted unless approved by the Engineer.

2. Threaded portions of valve and gate stems, machined surfaces which are limited for sliding contact, surfaces which are to be assembled against gaskets, surfaces or shafting on which sprockets are to fit, or which are intended to fit into bearings, machined surfaces of bronze trim on slide gates and similar surfaces shall be masked off to protect them from the sandblasting of adjacent surfaces. Cadmium-plated or galvanized items shall not be sandblasted unless hereinafter specified, except that cadmium-plated, zinc-plated, or sherardized fasteners used in assembly of equipment to the sandblasted shall be sandblasted in the same manner as the unprotected metal. All installed equipment, mechanical drives, and adjacent painted equipment shall be protected from sandblasting. Protection shall prevent any sand or dust from entering the mechanical drive units or equipment where damage could be caused.

3. Protect or remove, during painting operations, hardware, accessories, machined surfaces, nameplates, lighting fixtures, and similar items not intended to be painted prior to cleaning and painting. Reposition items removed upon completion of painting operations.

4. Examine surfaces to be coated to determine that surfaces are suitable for specified surface preparation and painting. Report to Engineer surfaces found to be unsuitable in writing. Do not start surface preparation until unsuitable surfaces have been corrected. Starting surface preparation precludes subsequent claim that such surfaces were unsuitable for the specified surface preparation or painting.

5. Surface preparation shall be in accordance with specifications and manufacturer's recommendations. Provide additional surface preparation, and fill coats where manufacturer recommends additional surface preparation, in addition to requirements of specification.

6. Touch-up shop or field applied coatings damaged by surface preparation or any other activity, with the same shop or field applied coating; even to the extent of applying an entire coat when required to correct damage prior to application of the next coating. Touchup coats are in addition to the specified applied systems, and not considered a field coat.

7. Protect motors and other equipment during blasting operation to ensure blasting material is not blown into motors or other equipment. Inspect motors and other equipment after blasting operations and certify that no damage occurred, or where damage occurred, the proper remedial action was taken.

8. Field paint shop painted equipment in compliance with Color Coding and as approved by Engineer.

B. Metal Surface Preparation

1. Prepare all welds to a minimum NACE weld preparation level “C” per NACE Standard SP0178. Provide additional weld preparation where required by the coating manufacturer. Contractor shall provide NACE SP0178 weld mold visual aids on site for evaluation of all weld preparation.

2. Conform to current The Society for Protective Coatings Standards (SSPC) Specifications for metal surface preparation. Use SSPC-Vis-1 pictorial standards or NACE visual standards TM-01-70 or TM-01-75 to determine cleanliness of abrasive blast cleaned steel.

3. Perform blast cleaning operations for metal when following conditions exist:

   a. Moisture is not present on the surface.

   b. Relative humidity is below 80%.

   c. Ambient and surface temperatures are 5°F or greater than the dew point temperature.

   d. Painting or drying of paint is not being performed in the area.

   e. Equipment is in good operating condition.

   f. Proper ventilation, illumination, and other safety procedures and equipment are being provided and followed.

4. Abrasive blast ferrous metals to be shop primed, or component mechanical equipment in accordance with SSPC-SP5, White Metal Blast.

5. Abrasive blast field prepared ferrous metals in accordance with SSPC-SP10, Near White Metal Blast, where metal is to be submerged, in a corrosive environment, or

in severe service. Provide a 3.0 mil minimum angular anchor profile unless recommended otherwise by the coating manufacturer in writing.

6. Abrasive blast field prepared ferrous metals in accordance with SSPC-SP6 Commercial Blast, where metal is to be used in mild or moderate service, or non-corrosive environment or weathering exposure. Provide a 1.5 mil minimum angular anchor profile unless recommended otherwise by the coating manufacturer in writing.

7. Clean nonferrous metals, copper, or galvanized metal surfaces in accordance to SSPC-SP1, Solvent Cleaning, or give one coat of metal passivator or metal conditioner compatible with the complete paint system. Galvanized metal shall be prepared in accordance with SSPC SP-16. Abrasive blast clean to increase mechanical adhesion in accordance with ASTM D6386, Standard Practice for Preparation of Zinc (Hot-Dip Galvanized) Coated Iron and Steel Product and Hardware Surfaces for Painting when required by coating manufacturer. Provide a 1.5 mil minimum angular anchor profile unless recommended otherwise by the coating manufacturer in writing.

8. Abrasive blast clean internal and external ductile iron pipe surfaces prior to coating in accordance with NAPF 500-03-04, Surface Preparations Standard for Abrasive Blast Cleaning of Ductile Iron Pipe. Abrasive blast clean internal and external cast ductile iron and cast-iron fitting surfaces in accordance with NAPF-03-05.

9. Prime cleaned metals immediately after cleaning to prevent rusting.

10. Clean rusted metals down to bright metal by abrasive blasting and immediately field primed.

11. Field surface preparation of small, isolated areas such as field welds, repair of scratches, abrasions or other marks to the shop prime or finish shall be cleaned by power tools in accordance with SSPC-SP-3, or in difficult and otherwise inaccessible areas by hand cleaning in accordance with SSPC-SP-2 and spot primed.

12. All shop-coated surfaces shall be protected from damage and corrosion before and after installation by treating damaged areas immediately upon detection. Abraded or corroded spots on shop-coated surfaces shall be prepared in accordance with SSPC-SP-2, Hand Tool Cleaning and then touched up with the same materials as the shop coat.

13. All shop coated surfaces which are faded, discolored, or which require more than minor touch-up, in the opinion of the Engineer, shall be repainted. Cut edges of galvanized sheets, electrical conduit, and metal pipe sleeves, not to be finish painted, shall be cleaned in accordance with SSPC-SP-1, Solvent Cleaning and primed with zinc dust-zinc oxide metal primer.

C. Concrete Surface Preparation

1. Cure concrete a minimum of 28 days at 75° F before surface preparation, and painting begins. Allow more time at lower temperatures if specified by paint manufacturer.

2. Test concrete for pH and salts using test methods recommended by the paint manufacturer. A minimum of one test per 1000 square feet of area to be coated shall be performed unless approved otherwise by Engineer. Do not begin surface preparation, or painting until acceptable to manufacturer.

3. Moisture content of concrete and masonry surfaces shall conform to manufacturer's recommended limits, and as listed in SSPC-SP13/NACE 6 Section 6 Acceptance Criteria Table 1. Floor surfaces to be coated shall be tested in accordance with ASTM F1869 – Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride or as required by the coating manufacturer. Moisture vapor transmission shall not exceed three pounds per 1,000 square feet in a 24-hour period or less if specified by Coating Manufacturer. Vertical and horizontal overhead surfaces shall be tested in accordance with ASTM F2170 – Standard Test Method for Determining Relative Humidity in Concrete using in situ Probes (relative humidity shall not exceed 80% or as required by the coating manufacturer) or with ASTM D4263 – Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Test Method (test results shall be no moisture present). Engineer or Coating Manufacturer Representative shall specify all test locations. A minimum of one test per 1000 square feet of area to be coated shall be performed unless approved otherwise by Engineer.

4. Prepare concrete surfaces to receive coatings in accordance with NACE 6/SSPC-13 – Joint Surface Preparation Standards and ICRI Technical Guidelines. Remove contaminants, open bugholes, surface voids, air pockets, and other subsurface irregularities using abrasive blasting, shot blasting, water jetting or mechanical abrading. Use dry, oil-free air for blasting operations. Surface texture after blasting shall achieve profile as required by manufacturer or where not defined by manufacturer, profile shall be a minimum ICRI-CSP 5 surface profile. Remove residual abrasives, dust, and loose particles by vacuuming or other approved method.

5. Surface defects, such as hollow areas, bugholes, honeycombs, and voids shall be filled with polymeric or waterborne epoxy cementitious filler compatible with painting system. Complete fill coats may be used in addition to specified painting system and as approved by the Engineer. Fins, form marks, and all protrusions or rough edges shall be removed.

6. Repair existing concrete surfaces which are deteriorated to the point that surface preparation exposes aggregate with fill coats or patching mortar as recommended by paint manufacturer and as directed by the Engineer.

7. Clean concrete of all dust, form oils, curing compounds, oil, tar, laitance, efflorescence, loose mortar, and other foreign materials before paints are applied.

8. To ease coating around outside corners, provide ¾-inch chamfered edges on all new concrete outside corners and grind existing concrete outside corners to a minimum radius of ¾-inch.

9. Unless recommended otherwise by the coating manufacturer, provide ¼" deep by ¼" wide tool cut terminations at 1-inch maximum from all coating edges for anchorage. Provide terminations around all equipment, piping, openings, gates, top and bottom of walls, stop locations of each day's work and overlap onto previously completed work. Transition coating 3-inches onto interior lining of piping except where coating compatibility concerns are noted by coating manufacturer.

10. Apply epoxy or polymeric filler compatible with painting system to all inside corners of areas to be coated with a margin trowel to form a continuous 45-degree can't cove across corners with a minimum dimension of 1.5-inch. Roughen or prepare cured filler as recommended by coating manufacturer for proper coating adhesion.

11. All equipment grouting shall be installed and cured prior to starting coating work. Coating shall be applied over grout up to the edges of all equipment, gates and uninterrupted piping unless specifically noted otherwise.

D. Wood

1. Clean wood surfaces free of all foreign matter, with cracks and nail holes and other defects properly filled and smoothed. Remove sap and resin by scraping and wipe clean with rags dampened with mineral spirits.

2. Saturate end grain, cut wood, knots, and pitch pockets with an appropriate sealer before priming.

3. Prime and backprime wood trim before setting in place.

4. After prime coat has dried, fill nailholes, cracks, open joints, and other small holes with approved spackling putty. Lightly sand wood trim prior to applying second coat of paint.

E. Castings

1. Prepare castings for painting by applying a brush or a knife-applied filler. Fillers are not to be used to conceal cracks, gasholes, or excessive porosity.

2. Apply one coat of primer with a minimum thickness of 1.2 mils in addition to coats specified. Allow sufficient drying time before further handling.

F. Exposed Pipe, Valves and Pumps

1. Bituminous coated pipe shall not be used in exposed locations. Pipe which shall be exposed after project completion shall be primed in accordance with the requirements herein. Any bituminous coated ferrous pipe which is inadvertently installed in exposed locations shall be sandblasted to SSPC-SP-5 White Metal before priming and painting.

2. After installation and prior to finish painting, all exterior, exposed flanged joints shall have the gap between adjoining flanges and gaps between the pipe wall and threaded-on flanges sealed with a single component Thiokol caulking to prevent rust stains

G. Masonry

1. Cure for a minimum of 30 days prior to paint application.

2. Clean masonry surfaces free from all dust, dirt, oil, grease, loose mortar, chalky deposits, efflorescence, and other foreign materials.

3. Test masonry for moisture content. Use test method recommended by paint manufacturer. Do not begin painting until moisture content is acceptable to manufacturer.

H. Gypsum Drywall

1. Sand joint compound with sandpaper to provide a smooth flat surface. Avoid sanding of adjacent drywall paper.

2. Remove dust, dirt, and other contaminants.

I. PVC Pipe Surfaces

1. All pipe surfaces shall be cleaned and lightly sanded before painting

J. Previously-Painted Surfaces

1. Totally remove existing paint when: surface is to be submerged in a severe environment, paint is less than 75% intact, brittle, eroded or has underfilm rusting.

2. Surfaces which are greater than 75% intact require removal of failed paints and then spot primed. Spot priming is in addition to coats specified.

3. Remove surface contamination such as oil, grease, loose paint, mill scale, dirt, foreign matter, rust, mold, mildew, mortar, efflorescence, and sealers.

4. Clean and dull glossy surfaces prior to painting in accordance with the manufacturer's recommendations.

5. Check existing paints for compatibility with new paint system. If incompatible, totally remove existing paint system or apply a barrier coat recommended by the paint manufacturer. Remove existing paints of undetermined origin. Prepare a test patch of approximately 3 square feet over existing paint. Allow test patch to dry thoroughly and test for adhesion. If proper adhesion is not achieved remove existing paint and repaint.

3.03 APPLICATION OF PAINT

A. Apply paint by experienced painters with brushes or other applicators approved by the Engineer, and paint manufacturer.

B. Apply paint without runs, sags, thin spots, or unacceptable marks.

C. Apply at rate specified by the manufacturer to achieve at least the minimum dry mil thickness specified. Apply additional coats, if necessary, to obtain thickness.

D. Paint shall be applied with spraying equipment only on those surfaces approved by the Engineer. If the material has thickened or must be diluted for application by spray gun, each coat shall be built up to the same film thickness achieved with undiluted brushed-on material. Where thinning is necessary, only the products of the particular manufacturer furnishing the paint shall be used; and all such thinning shall be done in strict accordance with the manufacturer's instructions, as well as with the full knowledge of the Engineer.

E. Surfaces not accessible to brushes or rollers may be painted by spray by dauber or sheepskins and paint mitt. If any of these methods is to be used, it shall be done in strict accordance with the manufacturer's instructions, as well as with the full knowledge of the Engineer.

F. Special attention shall be given to nuts, bolts, edges, angles, flanges, etc., where insufficient film thicknesses are likely. Stripe paint outside corners and edges in accordance with SSPC PA Guide 11. Stripe painting shall be in addition to coats specified.

G. Perform thinning in strict accordance with the manufacturer's instructions, and with the full knowledge and approval of the Engineer and paint manufacturer.

H. Allow paint to dry a minimum of twenty four hours between application of any two coats of paint on a particular surface, unless shorter time periods are a requirement by the manufacturer. Longer drying times may be required for abnormal conditions as defined by the Engineer and paint manufacturer. Do not exceed manufacturer's recommended drying time between coats.

I. Suspend painting when any of the following conditions exist:

1. Rainy or excessively damp weather.

2. Relative humidity exceeds 85%.

3. General air temperature cannot be maintained at 50□F or above through the drying period, except on approval by the Engineer and paint manufacturer.

4. Relative humidity will exceed 85% or air temperature will drop below 40□F within 18 hours after application of paint.

5. Surface temperature of item is within 5 degrees of dewpoint.

6. Dew or moisture condensation are anticipated.

7. Surface temperature exceeds the manufacturer's recommendations.

J. Where application of coating across concrete control joints or expansion joints has the potential to crack, turn coating into joints and caulk joints with a sealant compatible with coating rated for the intended service per Section 07 90 00 – Joint Fillers, Sealants, Caulking.

K. All surfaces which are to be installed against concrete, masonry etc., and will not be accessible for field priming and/or painting shall be back primed and painted as specified herein, before erection. Anchor bolts shall be painted before the erection of equipment and then the accessible surfaces repainted when the equipment is painted.

L. Painting found defective shall be scraped or sandblasted off and repainted as the Engineer may direct. Before final acceptance of the Work, damaged surfaces of paint shall be cleaned and repainted as directed by the Engineer.

3.04 INSPECTION

A. Each field coat of paint will be inspected and approved by the Engineer or his authorized representative before succeeding coat is applied. Tint successive coats so that no two coats for a given surface are exactly the same color. Tick-mark surfaces to receive black paint in white between coats.

B. Before application of the prime coat and each succeeding coat, any defects or deficiencies in the prime coat or succeeding coat shall be corrected by the Contractor before application of any subsequent coating

C. When any appreciable time has elapsed between coatings, previously coated areas shall be carefully inspected by the Engineer, and where, in his opinion, surfaces are damaged or contaminated, they shall be cleaned and recoated at the Contractor's expense. Recoating times of manufacturer's printed instructions shall be adhered to.

D. Coating thickness shall be verified by the use of a dry film thickness digital gauge. Gauge shall be Elcometer 456 or equal and shall be properly calibrated. Coating thickness on non-metal surfaces shall be verified by the use of an ultrasonic gauge. Ultrasonic gauge shall be Positector 200 or equal. Gauges shall include the entire range of coating thicknesses required in this section..

E. The Contractor shall provide free of charge to the Engineer two new digital dry film gauges and two wet film gauges to be used to inspect coating by Engineer and Contractor. One gauge may be used by Contractor and returned each day to the Engineer. Engineer will return gauges to Contractor at completion of job.

F. Coatings shall pass a holiday detector test.

G. Determination of Film Thickness: Randomly selected areas, each of at least 107.5 contiguous square feet, totaling at least 5% of the entire control area shall be tested. Within this area, at least 5 squares, each of 7.75 square inches, shall be randomly selected. Three readings shall be taken in each square, from which the mean film thickness shall be calculated. No more than 20 percent of the mean film thickness measurements shall be below the specified thickness. No single measurement shall be below 80 percent of the specified film thickness. Total dry film thickness greater than twice the specified film thickness shall not be acceptable. Areas where the measured dry film thickness exceeds twice that specified shall be completely redone unless otherwise approved by the Engineer. When measured dry film thickness is less than that specified additional coats shall be applied as required.

H. Holiday Testing: Holiday test painted ferrous metal surfaces which will be submerged in water or other liquids, or surfaces which are enclosed in a vapor space in such structures. Mark areas which contain holidays. Repair or repaint in accordance with paint manufacturer's printed instructions and retest.

1. Dry Film Thickness Exceeding 20 Mils: For surfaces having a total dry film thickness exceeding 20 mils: Pulse-type holiday detector such as Tinker & Rasor Model AP-W, D.E. Stearns Co. Model 14/20, shall be used. The unit shall be adjusted to operate at the voltage required to cause a spark jump across an air gap equal to twice the specified coating thickness.

2. Dry Film Thickness of 20 Mils or Less: For surfaces having a total dry film thickness of 20 mils or less: Tinker & Rasor Model M1 non-destructive type holiday detector, K-D Bird Dog, shall be used. The unit shall operate at less than 75-volts. For thicknesses between 10 and 20 mils, a non-sudsing type wetting agent, such as Kodak Photo-Flow, shall be added to the water prior to wetting the detector sponge.

I. Paint manufacturer’s NACE certified representative shall provide their services as required by the Engineer. Services shall include, but not be limited to, inspecting existing

paint, determination of best means of surface preparation, inspection of completed work, and final inspection of painted work 11 months after the job is completed.

3.05 PROTECTION OF ADJACENT PAINT AND FINISHED SURFACES

A. Use covers, masking tape, other method when protection is necessary or requested by Owner or Engineer. Remove unwanted paint carefully without damage to finished paint or surface. If damage does occur, repair the entire surface adjacent to and including the damaged area without visible lap marks and without additional cost to the Owner.

B. Take all necessary precautions to contain dispersion of abrasive blasting debris and paint to the limits of the work. Take into account the effect of wind and other factors which may cause dispersion of the abrasive blasting debris and paint. Suspend painting operations when abrasive blasting debris or paint cannot be properly confined. Assume all responsibilities and cost associated with damage to adjacent structures, vehicles, or surfaces caused by the surface preparation and painting operations.

3.06 PIPING AND EQUIPMENT IDENTIFICATION

A. Piping and equipment identification shall be in accordance with Section 40 05 97 – Piping and Equipment Identification Systems.

3.07 SCHEDULE OF COLORS

A. Match colors indicated. Piping and equipment colors are indicated in Section 40 05 97 – Piping and Equipment Identification Systems. Colors which are not indicated shall be selected from the manufacturer's full range of colors by the Engineer. No variation shall be made in colors without the Engineer's approval. Color names and numbers shall be identified according to the appropriate color chart issued by the manufacturer of the particular product in question.

3.08 WORK IN CONFINED SPACES

A. Provide and maintain safe working conditions for all employees. Supply fresh air continuously to confined spaces through the combined use of existing openings, forced draft fans and temporary ducts to the outside, or direct air supply to individual workers. Exhaust paint fumes to the outside from the lowest level in the contained space. Provide explosionproof electrical fans, if in contact with fumes. No smoking or open fires will be permitted in, or near, confined spaces where painting is being done. Follow OSHA, state/commonwealth, and local regulations at all times.

3.09 OSHA SAFETY COLORS

A. Paint wall around wall-mounted breathing or fire apparatus with the appropriate safety red color; area not exceed 2 feet wide by 3 feet high, unless apparatus covers the area. Fire apparatus include fire hoses, extinguisher, and hydrants.

B. Paint hazardous areas and objects in accordance with OSHA regulations.

3.10 VOC REGULATIONS

A. Provide paint systems in accordance with local, state, and federal regulations. Where paint systems shown in schedule do not comply substitute equal products with VOC limits which comply with local, state, and federal regulations.

(SEE TABLE 1 NEXT PAGE)

Table 1: Painting Schedule

Surface	Application	Painting System and No. of Coats	Product Reference (Table 2)	Total Min. Dry Film Thickness (Mils)
Concrete and Masonry				
Interior masonry and concrete walls and ceilings	All new structures	1 coat sealer 2 coats acrylic epoxy	101 116	75-85 sq.ft./gal. 4-6/coat
Interior masonry and concrete walls in chemical rooms		1 coat sealer 2 coats epoxy polyamide	117 102	60-80 sq.ft./gal. 4-6/coat
Exterior masonry and concrete	All new structures	1 coat sealer 2 coats modified waterborne acrylate	117 125	100-150 sq.ft/gal 4-6/coat
Submerged water	Water retaining side of new wall surfaces where opposite side of wall is interior and dry	1 coat surfacer 2 coats NSF approved epoxy polyamide	121 105	1/16” 4-6/coat
Submerged wastewater		1 coat surfacer 2 coats high solids epoxy	121 119	1/16” 6-10/coat
Containment Liner[1]	Interior and exterior secondary containment floors, tank supports and walls	1 coat epoxy modified mortar 1 coat modified polyamine epoxy 1 coat fiber reinforced polyamine epoxy 1 coat polyamine novolac epoxy	121 122 123 124	1/16” 6-10/coat 25-40/coat 6-10/coat
Metals				
Interior and exterior nonsubmerged (gloss)	All new blowers, pumps, motors and mechanical equipment, piping, etc.	1 coat epoxy polyamide primer 1 coat epoxy polyamide 1 coat aliphatic polyurethane	104 102 115	4-6 4-6 3-5
Interior insulated		1 coat acrylic latex	103	4
Submerged water	All metal piping, and mechanical equipment, etc.	2 coats NSF approved epoxy polyamide	105	4-6/coat
Submerged Wastewater		2 coats high solids epoxy	119	8-10/coat
Steel doors, windows and door frames, steel stairs, monorails, structural steel, misc. metals (steel)	Metal canopy systems, other misc. metals, etc.	1 coat epoxy polyamide 1 coat aliphatic polyurethane	102 115	5-8 3-4
Aluminum surfaces in contact with concrete		2 coats coal tar	107	26
Shop Primed Structural Steel	Pre-Engineered Buildings	1 tie coat 1 coat epoxy 1 coat epoxy	113 114 120	2-3 3-4 3-4
Other				
Interior: Gypsum Wallboard	All new structures	2 coats acrylic latex matte or satin	103	2-3/coat
Interior: Tar-dipped piping where color is required		2 coats epoxy resin sealer 2 coats epoxy polyamide	112 102	5-8/coat 5-8/coat
PVC Piping		1 coat epoxy polyamide 1 coat aliphatic polyurethane	102 115	5-8 3-4

1 Painting manufacturer shall verify compatibility of containment liner and chemical to be contained. Where incompatible substitute a compatible coating system.

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(TABLE 2 NEXT PAGE)

Table 2: Product Listing

Ref.	System	Purpose	Product			
			Tnemec Series	PPG/AMERON	CARBOLINE	Sherwin-Williams
101	Acrylic filler	Primer-sealer	130-6601	BLOXFIL 4000	Sanitile 100	Cement-Plex 875
102	Epoxy polyamide	Finish coat semi-gloss or gloss	N69	AMERLOCK 2	Carboguard 890	Dura-Plate 235
103	Acrylic latex	Sealer	1028/1029	PITT TECH PLUS	Carbocrylic 3359DTM	DTM Acrylic Primer/Finish
104	Epoxy Polyamide – metal	Primer	66	AMERCOAT 385	Carboguard 893SG	Macropoxy 646
105	Epoxy	Primer/Finish	N140	AMERLOCK 2	Carboguard 561/56LT	Macropoxy 646 PW
106	Coal tar epoxy	Finish high-coat build	46H-413	AMERCOAT 78HB	Bitumastic 300M	Hi-Mil Sher Tar Epoxy
107	Coal tar	Sealer	46-465	AMERCOAT 78HB	Bitumastic 300M	Hi-Mil Sher Tar Epoxy
108	Alkyd-medium oil	Finish coat	2H	DEVGUARD 4308	Carbocoat 8215	Industrial Enamel
109	Alkyd-long oil	Finish coat	1029	DEVGUARD 4308	Carbocoat 8215	Industrial Enamel
110	Epoxy polyamide	Primer	66-1211	AMERCOAT 385	Carboguard 893SG	Macropoxy 646
112	Epoxy polyamide	Sealer	66-1211	AMERCOAT 385	Carboguard 893SG	Macropoxy 920 Pre-Prime
113	Urethane	Barrier coat	530	AMERLOCK SEALER	Rustbond	-
114	Polyamine Epoxy	Intermediate coat	27	AMERLOCK 385	Carboguard 893SG	-
115	Aliphatic Polyurethane	Finish coat	1074 or 1075	AMERCOAT 450 HS	Carbothane 134HG	Acrolon 218HS
116	Acrylic epoxy	Finish coat	113 or 114	AQUAPON WB	Sanitile 255	Water-Based Catalyzed Epoxy
117	Epoxy block filler	Sealer	1254	AMERLOCK 114	Sanitile 600	Kem Cati-Coat HS Epoxy Filler
118	Catalyzed epoxy	Finish coat	84	AMERLOCK 2/400	Carboguard 890	Macropoxy 646
119	High solids epoxy	Finish coat	104	AMERLOCK 400	Carboguard 890	Dura-Plate 235
120	Epoxy	Top coat	N69	AMERLOCK 2/400	Carboguard 890	-

Ref.	System	Purpose	Product			
			Tnemec Series	PPG/AMERON	CARBOLINE	Sherwin-Williams
121	Epoxy modified cementitious mortar	Surfacer	218		Carboguard 510 SG	Corobond 300
122	Modified polyamine epoxy	Intermediate coat	201		Carboguard 1340	Corobond 100
123	Fiber reinforced polyamine epoxy	Intermediate coat	270		Sanitile 755	Cor-Cote HCR Clear with 1 oz glass mat
124	Polyamine novolac epoxy	Finish coat	282		Sanitile 949	Cor-Cote HCR FF
125	Modified waterborne acrylate	Finish coat	156/157		Flexxide Elastomer	Loxon XP

END OF SECTION

DIVISION 10 – SPECIALTIES

SECTION 10 14 00
IDENTIFYING DEVICES

PART 1 – GENERAL

1.1 THE REQUIREMENT

A. Furnish all labor, materials, equipment and appliances required for the complete execution of the Work as shown on the Drawings and specified herein.

B. Principal items of work include:

1. Fire related signs

2. Caution signs

3. Safety signs

4. Hazardous classification signs

1.2 SUBMITTALS

A. In accordance with the procedures and requirements set forth in Section 01 33 00 – Submittal Procedures, submit the following:

1. Color and finish samples for all nameplates, signs and building name letters.

2. Shop Drawings shall include, but not be limited to:

a. Complete details for all signs and building name letters giving sizes and styles of lettering and colors.

b. Complete schedules for all nameplates, signs, and building name letters giving location, message, letter, size, color, and method of attachment.

c. Details of fabrication and attachment of all items.

1.3 DELIVERY, STORAGE AND HANDLING

A. Deliver all materials in unopened, unbroken and undamaged original packaging bearing the manufacturer's label and identification for installation.

B. Handle all materials with care to prevent defacement of any nature.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Specifications, provide products from one of the following manufacturers:

1. Exterior and Interior Scheduled Signage

    a. Seton Corporation

    b. Safety Sign a division of Brimar Industries, Inc.

    c. Emedco

    d. Or equal

2.2 MATERIALS

A. Signs

1. Scheduled fire related, caution, safety, and hazardous material signs to be mounted in building interiors or on exterior structures shall be 0.040” minimum aluminum with vinyl lettering and numbering. Provide signs with clear overlaminate protection to resist fading and damage from UV, chemicals, dirt, oil, and grime.

2. Scheduled hazardous material and safety signs mounted to exterior tanks shall be self-adhesive vinyl type. Provide signs with clear overlaminate protection to resist fading and damage from UV, chemicals, dirt, oil, and grime.

2.3 ACCESSORIES

A. Exterior and Interior Mounting Hardware: Stainless steel screws and hardware for aluminum signs.

B. Exterior Tank Mounting: Permanent adhesive.

2.4 FABRICATION

A. All items specified herein to be factory fabricated to the extent practicable.

PART 3 – EXECUTION

3.1 INSTALLATION

A. All materials specified herein shall be installed in compliance with the approved manufacturer's printed specifications. Mounting devices, bolts, screws, nuts and the like shall be of high strength aluminum or stainless steel. The final location of each sign shall be as determined by the Engineer.

B. Plastic door numbers and room name plates shall be attached stainless steel oval Phillips head screw at each corner.

1. Submit a schedule of door numbers and name plates to the Engineer for approval.

2. Install door and name plates after final field finish has been applied and thoroughly dried.

3.2 ADJUSTMENT AND CLEANING

A. After completion of project, remove all protective devices, touch up as necessary and clean all exposed surfaces with a mild solution of detergent and warm water. Leave all surfaces in a neat and clean condition.

3.3 SCHEDULES

A. Fire-related signs provide each sign with wording and pictogram. Signs shall have red background and white letters and pictogram. (ADA Compliant.)

Wording	Size	Quantity
FIRE EXIT (stair)	7x10	2

B. Caution signs shall have a yellow background with the word CAUTION 2 inches high with black letters and yellow background centered above wording below in black letters. Each sign shall be provided with pictogram showing figure in compliance with sign (i.e. a figure wearing glasses).

Wording	Size	Quantity
EYE PROTECTION MUST BE WORN IN THIS AREA	7x10	2
NON-POTABLE WATER – DO NOT DRINK	7X10	2

C. Safety Signs. Signs shall comply with ANSI Z 535 requirements and/or OSHA 1910.1200(c).

Wording	Size	Quantity
EMERGENCY SHOWER (with pictogram)	7x10	5
EMERGENCY EYEWASH (with pictogram)	7x10	5
NO SMOKING NO VAPING (with pictogram)	7X10	2
SODIUM HYPOCHLORITE 12.5% (prevention, response, storage GHS with pictogram)	12x14	2

D. Exterior Hazardous Material Building Signage

1. The authority having jurisdiction shall be consulted regarding the quantity and placement of identification NFPA 704 placard to assist in response to incidents at locations.

Wording	Size	Quantity
In accordance with NFPA 704 for Sodium Hypochlorite	10X10	8

END OF SECTION

SECTION 10 43 10
CHEMICAL HANDLING SAFETY EQUIPMENT

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. Furnish and install chemical handling safety equipment as shown on the Drawings and as specified herein. Coordinate work in this Section with painting and marking as specified in Section 09 90 00 – Painting. Certain equipment items will be field located by Owner, if not otherwise shown on the Drawings.

1.02 SUBMITTALS

A. Submit Shop Drawings, Operation and Maintenance Instructions, and other information as specified for all items of equipment in this Section in accordance with Section 46 00 00 – Equipment General Provisions and Section 01 33 00 – Submittals. Shop Drawings shall also include complete erection, installation, and adjustment instructions and recommendations.

1.03 MANUFACTURERS

A. The materials covered by these Specifications are intended to be standard equipment of proven reliability and as manufactured by reputable manufacturers having experience in the production of such equipment. The equipment furnished shall be designed, constructed, and installed in accordance with the best practices and methods and shall operate satisfactorily when installed as shown on the Drawings and operated per manufacturers' recommendations.

PART 2 – PRODUCTS

A. Chemical Handling Safety Equipment shall include respirators, chemical splash goggles, and chemical resistant work aprons, gloves and boots as manufactured by Fisher Scientific, Mine Safety Appliances, or equal.

B. Respirators shall be twin replaceable cartridge-type bearing NIOSH approval. Cartridges shall be as recommended by the manufacturer. Three (3) complete respirator units each with six (6) replacement cartridges shall be provided.

C. Chemical splash goggles shall have soft vinyl frames with optical quality, distortion-free, replaceable plastic lenses. Three (3) splash goggles shall be provided.

D. Chemical resistant work aprons and gloves shall be cloth with a double coating of abrasion-resistant and chemical resistant elastomer. Chemical resistant boots shall have

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non-slip soles and steel shank and toe and shall be coated with a chemical resistant elastomer. Sizes of gloves and boots shall be selected by the Owner. Three (3) complete sets of aprons, gloves and boots shall be provided.

E. Chemical Handling Safety Equipment shall be stored in a wall-mounted double door steel cabinet of approved size to prevent cramping of equipment specified. Cabinet shall be field located as directed by the Engineer or Owner.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Chemical handling safety equipment shall be installed where shown on the Drawings or as directed by the Engineer. Where required by OSHA regulations, the background of the mounting location shall be painted the appropriate color.

END OF SECTION

SECTION 10 73 16
CANOPIES

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. Work in this Section includes furnishing and installation of extruded aluminum, post supported canopies and hanger rod canopies with perimeter gutter.

B. Coordination Items and Considerations

1. Concrete footings for post supported canopies. Footing styrofoam block outs and/or anchor rods shall be provided by manufacturer to be installed as part of concrete work.

2. Flashing.

3. Water drainage away from canopy.

4. Coordination of all electrical fixtures and conduits or other items that are planned to be attached to the canopy.

1.02 QUALITY ASSURANCE

A. Products meeting these specifications established standard of quality required as manufactured by a manufacturer with a minimum of 10 years of experience manufacturing and designing canopy systems.

1.03 SHOP DRAWINGS

A. Confirm dimensions prior to preparation of shop drawings when possible.

B. Supply manufacturer’s standard literature and specifications for canopies.

C. Submit shop drawings and structural calculations. Shop drawings shall include plan dimensions, elevations, and details, including drainage, connections, and means of anchoring posts. Shop drawings and structural calculations shall be sealed by a currently licensed Professional Engineer in the State or Commonwealth in which the project is located.

D. Coordinate and show location and approved attachment methods for electrical fixtures, lightning protection, and conduits and other items that require attachment to the canopy on the Shop Drawings.

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1.04 PERFORMANCE REQUIREMENTS

A. Canopy must be designed for gravity loads, collateral loads, wind, seismic, snow, and live load requirements of the governing building code.

B. Canopy must be designed to support additional accessories (electrical conduits and fixtures, etc.) attached to canopy system (posts, beams, ceiling, fascia, etc.).

C. Electrical accessories including but not limited to lighting, switches and associated electrical conduits shall be coordinated with the canopy manufacturer. Attachment points shall not penetrate roof system or water conveying systems (wet columns and beams).

D. Process control panels, electrical panels, etc. and associated conduits shall be provided with a support system independent of the canopy system.

1.05 DELIVER, STORAGE, HANDLING

A. Deliver and store all canopy components in protected areas.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Mapes Industries, Inc.

B. Peachtree Protective Covers, Inc., Hiram, Georgia.

C. Dittmer Architectural Aluminum, Winter Springs, Florida.

D. AVAdek, Houston, Texas.

E. Mitchell Metals

F. MASA Architectural Canopies

G. Or approved equal.

2.02 MATERIALS

A. Decking, beams, posts, and fascia shall be extruded aluminum, alloy 6063-T6, in profile and thickness indicated.

B. Decking shall be extruded and shall be at least 0.078” thick.

C. Thickness of metal comprising posts shall be 0.125” minimum. Thickness of metal comprising beams shall be 0.125” minimum.

D. Fascia shall be standard 6” extruded members with a minimum metal thickness of 0.0625”.

E. All bolts and fasteners shall be stainless steel and sized by designer of canopy system.

F. Galvanized steel hanger rods shall be 3/4” minimum diameter. Provide required accessories for complete installation.

2.03 FINISHES

A. Finish shall be standard two-coat Kynar. Color shall be selected by the Owner from manufacturer’s standard range of colors. Steel hanger rods and accessories shall match color of canopy.

2.04 FABRICATION

A. Welding shall follow AWS 1.2.

B. Connections between posts and beams shall be designed to resist a minimum force of 350 lb.

C. Decking shall be designed with interlocking extruded aluminum members with mechanical fasteners field applied to provide structural integrity for the completed assembly.

D. Concealed drainage. Water shall drain from covered surfaces into integral gutter beam and be directed to ground level discharge via one or more designated support posts or downspout for cantilevered canopies.

PART 3 – EXECUTION

3.01 INSPECTION

A. Confirm that surrounding area is ready for the canopy installation.

B. Installer shall confirm dimensions and elevations to be as shown on drawings provided by manufacturer.

C. Erection shall be performed by an approved installer and scheduled after all concrete, masonry and roofing in the area is completed.

3.02 INSTALLATION

A. Installation shall be in strict accordance with manufacturer’s erection drawings. Particular attention should be given to protecting the finish during handling and erection. Canopy shall be erected true to line, level, and plumb.

B. Do not install items to the canopy system which have not been coordinated and approved by the canopy manufacturer.

C. After installation, entire system shall be left in a clean condition.

END OF SECTION

DIVISION 13 – SPECIAL CONSTRUCTION

SECTION 13 34 19
METAL BUILDINGS

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. Provide all labor, materials, equipment and incidentals as shown, specified, and required by the metal building manufacturer to furnish and install all metal building Work. The Work shall include but is not limited to:

1. The building extent shown on the Drawings.

2. Multi-span rigid frame systems and clear-span rigid frame systems.

3. Louvers, windows, doors, hardware, and skylights.

4. Framed openings.

5. Metal roof system.

6. All accessories, trim flashing, closures, gutters, downspouts, and all other items not specified under this or other sections but required to provide a completely watertight and functioning building complying with these specifications.

7. Overhead doors, base moldings, roof hatch, roof walkway or any other attachments unique to the project.

B. The manufacturer shall design and fabricate the metal structural system including primary and secondary member connections, purlins, girts, roof and wall panels, bracings, fasteners, connections, sealants, gutters, downspouts, frame openings for louvers, doors and windows, anchor bolts, and all other parts required for a complete installation.

C. All steel shall be field painted in accordance with the requirements of section 09 90 00, “Painting”.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Requirements of related work are included in Division 1 of these Specifications.

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of other requirements of these Specifications, all work herein shall conform to or exceed the applicable requirements of the following

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documents to the extent that the provisions therein are not in conflict with the requirements of this Section.

1. Florida Building Code

2. Metal Building Manufacturers Association (MBMA), "Metal Building Systems Manual" and "Recommended Design Practices Manual"

3. American Institute of Steel Construction, "Manual of Steel Construction"

4. American Iron and Steel Institute, "Cold Formed Steel Design Manual"

5. American Welding Society, Structural Welding Code

6. The Aluminum Association, "Aluminum Construction Manual"

7. Steel Structures Painting Council, "Steel Structures Painting Manual, Vol. 2"

8. Underwriters Laboratories Incorporated (U.L.), "Bulletin of Research No. 52

9. All written requirements published by the building manufacturer

10. International Accreditation Service AC 472, Criteria for Inspection Programs for Manufacturers of Metal Building Systems

1.04 DESIGN CRITERIA

A. Building Description:

1. The building overall dimensions shall be as shown on the Drawings. Column locations shall be as shown on the Drawings unless otherwise accepted by the Engineer. The roof shall have a slope as indicated on the drawings.

B. Design Loads:

1. The metal building system shall be designed for the loads indicated in the Specifications and Drawings.

2. Dead Load shall be the total weight of the metal building including all attachments to the structure. Loads imposed on the building by piping, ductwork and other equipment shall be considered as dead load on the structure. All piping shall be assumed to be running full of sludge for design purposes.

3. Roof live load shall be 20 PSF, or greater as required by the Florida Building Code, on the horizontal projection of the roof.

4. Wind load pressure shall be based on an ultimate design wind velocity of 180 MPH -3 second gust, Exposure C, corresponding to Risk Category III buildings and

structures. Wind loads shall be calculated based upon the specified methods in the Florida Building Code and ASCE 7-22 assuming a partially enclosed structure.

5. Equipment loads shall be as specified on the drawings.

6. Load combinations shall be as specified in ASCE 7.

1.05 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittal Procedures.

1. All design data and calculations shall be neatly prepared to facilitate review and shall be signed and stamped with the seal of a Registered Professional Engineer licensed to practice in the State of Florida and who is a recognized expert in this type of construction. The calculations shall be submitted to the Engineer prior to fabrication and concrete foundation placement.

2. Dimensioned shop drawings showing the building plans including column centerlines, building reactions to the foundation, elevations and cross-sections. Shop drawings shall be signed and stamped with the seal of a Registered Professional Engineer licensed to practice in the State of Florida.

3. Manufacturer's product information, specifications, and installation instructions for building components and accessories.

4. Color selection chart from the manufacturer indicating finish color on all exterior wall panels, trims and roof drainage accessories.

5. Complete erection drawings showing anchor bolt settings, sidewall, endwall and roof framing, covering and trim details, and accessory installation details to clearly indicate the proper assembly of building components.

6. Comprehensive anchor design for all column baseplates and any other connections to concrete mat foundations, footings, or pedestals. Anchor design shall include embedment depth and any necessary additional reinforcement to accommodate loads to foundation. If metal building manufacturer desires anchor embedment and details to be designed by others, submittal shall include maximum factored reactions in tension and compression at each column and any other base connections. Factored reactions shall be for the worse case load combinations to provide the maximum factored reactions in accordance with applicable Building Code and ACI (American Concrete Institute) 318 requirements. Load factors used shall be in accordance with ACI 318.

7. 12-inch long by actual width samples of roofing and siding panels, with required finishes.

8. Samples of fasteners for application of roofing and siding panels

9. Samples of sealants and closures

10. Copy of accreditation certificate showing metal building system manufacturer’s qualifications per IAS AC 472 as described in Paragraph 1.05 below.

11. Copy of AISC Certified Erector certification showing the metal building system erector's qualifications as described in Paragraph 1.07 below

12. Guarantees described in Paragraph 1.09 below.

13. Florida Product Approvals for all building components and cladding.

1.06 MANUFACTURER'S QUALIFICATIONS

A. The manufacturer of the metal building systems shall be a manufacturer which has successfully engaged in work of this nature for at least the past five years and is an active member of the Metal Building Manufacturers Association.

B. The metal building system manufacturer shall be accredited by IAS AC 472 as a certified metal building systems manufacturer.

C. The metal buildings shall be as manufactured by Varco Pruden Metal Building Systems, Memphis, Tennessee; CECO Building Systems, Columbus MS; Butler Manufacturing Company, Kansas City, MO; American Building Company, Eufaula, AL.

1.07 ERECTOR QUALIFICATIONS

A. Furnish the names of all erector proposed to use for this work including necessary evidence and/or experience records to ascertain their qualifications in the erection of metal buildings.

B. Erector qualifications shall include a certified letter from the metal building manufacturer, on the manufacturer's letterhead, signed by an officer of the company stating that the erector is on the manufacturer's approved list of contractors.

C. The metal building system erector shall be an AISC Certified Erector.

1.08 QUALITY ASSURANCE

A. Shop inspection may be required by the Owner at the Owner's expense. The Contractor shall give ample notice to the Engineer prior to the beginning of any fabrication Work so that inspection may be provided. The Contractor shall furnish all facilities for the inspection of materials and workmanship in the shop and inspectors shall be allowed free access to the necessary parts of the work. Inspectors shall have the authority to reject any materials or Work which does not meet the requirements of these Specifications. Inspection at the shop is intended as a means of facilitating the Work and avoiding errors, but it is expressly understood that it will in no way relieve the

Contractor from its responsibility for furnishing proper materials or workmanship under this Specification.

B. The Owner may engage inspectors to inspect welded connections and to perform tests and prepare test reports.

1. Ten percent of all butt and bevel welds which extend continuously for 24 inches or less may be completely tested in accordance with AWS DI.1, Part B, Radiographic Testing of Welds, Chapter 6. All butt and bevel welds which extend continuously for more than 24 inches may be spot tested at intervals not exceeding 36 inches.

2. Welds that are required by the Engineer to be corrected shall be corrected or redone and retested as instructed, at the Contractor's expense by an acceptable independent testing lab and to the satisfaction of the Engineer.

1.09 GUARANTEES

A. All work performed on this project shall be free from defective materials and workmanship for a period of five years from date of acceptance by the Owner. The building manufacturer shall provide a warranty on defective materials for a period of five years from acceptance.

B. The finish of the wall panels and roof panels shall be warranted by the building manufacturer for 10 years against blistering, peeling, cracking, flaking, chalking and chipping. Color change shall not exceed 5 NBS units as per ASTM D 2244. Caulking shall not be less than a rating of 8 as per ASTM D 659.

C. All guarantees shall be submitted to the Engineer for approval and will be effective from the date of acceptance by the Engineer.

1.10 COORDINATION

A. The Contractor shall properly coordinate building design and installation with other trades. Doors, roll-up doors, and louvers specified herein are not manufactured by the building manufacturer and will have to be provided and coordinated with the building installation by the Contractor.

PART 2 – GENERAL

2.01 GENERAL

A. All work shall conform to the following list which shall be considered as minimum standards:

1. Hot-Rolled Structural Shapes – ASTM A36 or A529

2. Tubing or Pipe – ASTM A500, Grade B and ASTM A501 or A53

3. Plate or Bar – ASTM A529, A570, or A572

4. Cold Formed Members – ASTM A607, Grade 50

5. Galvanized Steel Sheet – ASTM A653 Class G90

6. Threaded Steel Rods – ASTM A36 or A572, Grade D

7. Bolts – ASTM A325

8. Anchor Bolts – ASTM A307

9. Panels – ASTM A792

B. All materials shall be new, unused, free from defect and of American manufacturer.

2.02 PRIMARY FRAMES

A. Frames shall be fabricated from hot rolled structural steel, shop welded, built-up "I" shapes consisting of variable depth rafters and either tapered or parallel-flanged columns complete with baseplates and splice plates.

B. Rigid Frames shall be designed as pinned base.

C. Width of span and spacing of frames shall be as indicated on the Drawings.

D. Shop drill frames for bolted field assembly.

E. Vertical diagonal bracing shall be permitted only in sidewalls. Horizontal bracing will be permitted providing it is above the building's required interior clear height.

F. Portal frames or wind posts will be permitted where bracing is considered to be an obstruction, except where functional interferences are created.

G. All cap plates, compression plates, stiffener plates, and base plates shall be factory welded into place, and have the bolt connection holes shop fabricated.

H. Columns and roof beams shall be shop fabricated, complete with holes in flanges for the attachment of secondary structural members except for field work as noted on the manufacturer's erection drawings.

I. Endwall framing shall be achieved by primary framing specified herein. Channel framing will not be acceptable.

2.03 SECONDARY FRAMING

A. Secondary framing shall include but is not limited to purlins, girts, eave struts, endwall posts, trim angles and channels, flange braces, and sag bracing.

B. Framing members shall be a minimum 16 gage shop painted either cold formed, hot rolled, or built up steel sections.

C. Purlin and girt configuration, thickness, and spacing shall be the building manufacturer's standard provided that all design criteria in the referenced standards including deflection, are met or exceeded.

D. Diagonal bracing shall be provided with rods. Cable bracing will not be acceptable. Where indicated on the drawings that portal frames are required, vertical diagonal bracing is not allowed and lateral load resistance in direction perpendicular to main frames shall be achieved with a bidirectional moment-resisting frame. Horizontal diagonal bracing shall be provided with rods. Cable type bracing will not be acceptable.

E. All diagonal bracing and sag rods, when required, shall be hot-rolled having a minimum yield point of 50,000 psi. Flange braces, purlin braces and sag rods, when required, shall be cold formed having a minimum yield point of 50,000 psi.

2.04 BOLTED AND WELDED CONNECTIONS

A. All field connections in main framing members shall be bolted, using high strength bolts, in accordance with the requirements of ASTM A 325. High strength bolts shall be hot dip galvanized. Field connections between main and secondary framing members shall be made with either ASTM A 325 or A 307 bolts. All ASTM A 307 bolts shall be hip dip galvanized. All bolted connections shall contain at least two bolts minimum.

B. The laying surfaces of all bolted connections shall be smooth and free from burrs or distortions.

C. All shop connections shall be welded in accordance with the American Welding Society "Structural Welding Code." Welding of steel sections shall be submerged arc or gas shielded arc process.

2.05 ROOF SYSTEM

A. The roof construction shall carry an Underwriter's Laboratories wind uplift Class 90 rating or better to meet the Florida Building Code. Roof panels shall be capable of resisting wind, dead, and live load forces as specified in Paragraph 1.04.

B. Roof panels shall be of the ribbed type. The panel material shall be min. 24 gage steel (or greater to resist specified loads) with a minimum yield of 42,000 psi. Finish shall be Zinc-Aluminum Alloy coated per ASTM A 792. Roof panels shall be painted with a fluoropolymer coating containing 70 percent “Kynar 500”. Roof system shall be PBR ribbed by United Structures of America, Butlerib II Roof System by Butler Manufacturing Company, or approved equal.

C. Roof panels shall be factory punched at panel ends to match pre-punched holes in structural members. Eave and splice panels shall have slots to provide for expansion and contraction.

D. The panels shall be precision roll-framed to provide width coverage of 2-feet minimum.

E. Ridge panels when required shall be one piece, factory covered to match the roof slope.

F. Roof slope shall be as indicated on Drawings.

G. Openings 8" or smaller may be flashed and sealed to the roof panel by elastomeric boots provided complete structural support and weather tightness are maintained.

H. Openings larger than 8" shall be framed with a welded metal roof curb completely supported by the roof system, and with flanges configured to match the roof panel. The curb shall be sealed to provide complete weather tightness.

I. All curbs and boots shall be an integral component of the roofing system designed and supplied by the metal building manufacturer.

2.06 WALL SYSTEM

A. The wall panels and connections shall be capable of withstanding wind forces as specified in Paragraph 1.04 - Design Criteria. Wall panels shall be PBR ribbed by United Structures of America, Butlerib II Wall System by Butler Manufacturing Company, or approved equal.

B. The panel material shall be 24 gauge galvanized steel with a minimum yield strength of 42,000 psi. Finish shall be Zinc-Aluminum Alloy coated per ASTM A 792. Wall panels shall be painted with a fluoropolymer coating containing 70 percent “Kynar 500”.

C. The panels shall be precision roll-formed to provide a width coverage of 3 feet minimum. The panels shall have at least one major corrugation per foot of 1-1/2-inch minimum thickness and minor corrugations in between to provide rigidity.

D. All wall panels shall be one piece from base to building eave unless otherwise indicated on the Drawings. The bottom end of panels shall be straight cut and shall be sealed with foam closures. All holes shall be factory pre-punched at panel ends to match the pre-punch holes in structural members.

2.07 INSULATION (NOT USED)

2.08 ACCESSORIES

A. General - Coordinate supply and installation of all accessory items. Coordinate framed opening requirements of accessory items with supplier. Provide special members,

fasteners, and hardware required for proper securement and installation of accessory items.

B. Pedestrian doors shall meet requirements of Section 08 11 13 – Steel Doors and Frames. Provide header, jamb, and other structural members required for framed opening. Provide trim and flashing required for a weathertight installation.

C. Overhead coiling door shall meet requirements of Section 08 33 23 – Roll-Up Doors. Provide header, jamb, and other structural members and fasteners required for framed opening. Provide trim and flashing required for a weathertight installation.

D. Louvers shall meet requirements of Section 08 90 00 – Louvers and Dampers. Provide header, jamb, and other structural members and fasteners required for framed opening. Provide trim and flashing required for a weathertight installation.

E. Windows shall meet the requirements of Section 08 51 13 – Aluminum Windows and Frames. Provide header, jamb, sill and other structural members and fasteners required for framed opening. Provide trim and flashing required for a weathertight installation.

2.09 SEALANTS AND CLOSURES

A. Sealants shall be asphaltic, nonhardening, nonshrinking, nonstaining, noncorrosive and nontoxic.

B. Closures shall match the panel profile and shall be installed as required to provide a weather tight building.

2.10 GUTTERS AND DOWNSPOUTS

A. Gutters and downspouts shall be fabricated from 26-gauge steel minimum with 70% Kynar coating. Color shall be selected by Engineer.

B. Downspouts shall be approximately 4-inches by 5-inches and shall be spaced according to the building manufacturer's standards.

2.11 MAINTENANCE STOCK

A. Provide a minimum of 5 percent access over the required amount of metal wall panels, metal roof panel, roof insulation, nuts, bolts, screw, washers and other required fasteners for building.

B. Pack in cartons and store on the site where directed.

PART 3 – EXECUTION

3.01 DESIGN

A. The building shall be as designed for dead, live, and wind loads according to the recommendations of the referenced standards.

B. Roof framing shall be designed for an additional live load of 5 psf to accommodate piping and lighting.

C. The building shall be designed for all loads and equipment shown on the Drawings.

D. The building anchor bolts shall be designed by the building manufacturer to resist all column reactions. Anchor bolts shall be furnished by the Contractor and shall be installed per recommendations using a manufacturer's supplied template.

E. The Engineer shall verify the foundation capacity for the reactions provided by the Building Manufacturer.

3.02 FABRICATION

A. Design prefabricated components and necessary field connections required for erection to permit easy assembly and disassembly. Fabricate components in such a manner that once assembled, they may be disassembled, repackaged, and reassembled with a minimum amount of labor.

B. Clearly and legibly mark each piece of the assembly to correspond with previously prepared erection drawings, diagrams, and instruction manuals.

C. Shop connections shall be bolted or welded.

D. Field connections shall be bolted.

3.03 PAINTING

A. Materials

1. The painting systems shall be compatible with Section 09 90 00 – Painting.

B. Shop Painting

1. All fabricated steel work and materials shall receive at the factory at least one shop coat of prime paint compatible with the paint system required by Section 09 90 00 – Painting. Surface preparations prior to shop painting shall be as specified in Section 09 90 00 - Painting. Finish coats may be applied in the shop if approved by the Engineer. All shop painted items shall be properly packaged and stored until they are incorporated in the work. Any painted surfaces that are damaged during handling, transporting, storage, or installation shall be cleaned, scraped,

and patched before field painting begins so that the work shall be equal to the original painting received at the shop. Steel work or materials that are to be assembled on the site shall likewise receive a minimum of one shop coat of paint at the factory.

2. The Contractor shall specify the shop paints to be applied when ordering materials in order to assure compatibility of shop paints with field paints. The paints and surface preparation used for shop coating shall be identified on shop drawings to the Engineer for approval. Where a compatible shop primer is not available, or when the surface preparation prior to application of the shop primer does not meet the requirements of Section 09 90 00 - Painting, the Contractor shall totally remove shop primer and provide paint system specified in Section 09 90 00 – Painting.

3.04 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver and store prefabricated components, sheets, and panels, and other manufactured items so that they will not be damaged or deformed.

B. Stack materials on platforms or pallets, covered with tarpaulins or other suitable weathertight ventilated covering.

C. Store metal sheets or panels so that water accumulations will drain freely.

D. Do not store sheets or panels in contact with other materials which might cause staining.

3.05 ERECTION

A. Erection of metal building, accessories, insulation and the interior finish, if applicable shall be performed by an AISC Certified Erector in accordance with Article 1.06 above.

B. The installation of the metal building shall be coordinated with any work which is to be installed with or attached to the metal building.

3.06 SETTING BASES AND BEARING PLATES

A. Prior to the placement of non-shrink grout beneath base and bearing plates, the bottom surface of the plates shall be cleaned of all foreign materials, and concrete and masonry bearing surface shall also be cleaned of all foreign materials and roughened to improve bonding.

B. Loose and attached baseplates and bearing for structural members shall be set on wedges, leveling nuts, or other adjustable devices.

C. Anchor bolts shall be tightened after the supported members have been positioned and plumbed and the non-shrink grout had attained its specified strength.

D. Baseplates shall be grouted with non-shrink grout to assure full uniform bearing. Grouting shall be done prior to placing loads on the structure.

3.07 FIELD ASSEMBLY

A. Structural frames shall be set accurately to the lines and elevations indicated. The various members shall be aligned and adjusted to form a part of a complete frame or structure before being permanently fastened. Bearing surfaces and other surfaces which will be in permanent contact shall be cleaned before assembly. Necessary adjustments to compensate for discrepancies in elevations and alignments shall be performed, as necessary.

B. Individual members of the structure shall be leveled and plumbed within specified AISC tolerances. The Contractor shall provide and install all temporary bracing required until structure is complete.

3.08 MISFITS AT BOLTED CONNECTIONS

A. Where misfits in erection bolting are encountered, the Engineer shall be immediately notified. The Contractor shall submit a method to remedy the misfit for review by the Engineer. The Engineer will determine whether the remedy is acceptable or if the member shall be refabricated.

B. Incorrectly sized or misaligned holes in members shall not be enlarged by burning or by the use of drift pins. The Contractor shall notify the Engineer immediately, and shall submit a proposed method of remedy for review by the Engineer. The Engineer will determine whether the remedy is acceptable.

3.09 MISFITS AT ANCHOR BOLTS

A. Where misalignment between anchor bolts and bolt holes in steel members are encountered, the Engineer shall be immediately notified. The Contractor shall submit a method to remedy the misalignment for review by the Engineer. The Engineer will determine whether the remedy is acceptable. The Contractor shall abide by the Engineer's decision.

3.10 GAS CUTTING

A. Gas cutting torches shall not be used in the field for correcting fabrication errors in the structural framing, except when acceptable to the Engineer. Gas-cut sections shall be finished equal to a sheared appearance.

END OF SECTION

DIVISION 22 – PLUMBING

SECTION 22 15 00

DOMESTIC WATER PIPING, SPECIALTIES, AND EYEWASH SHOWERS

PART 1 – GENERAL

1.01 SUMMARY

A. This Section includes the following domestic water piping, specialties, and appurtenances:

1. Copper piping and fittings
2. Backflow preventers
3. Hose bibbs
4. Washdown hose
5. Emergency eyewash showers

1.02 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig, unless otherwise indicated.

1.03 RELATED WORK

A. Section 00 72 00 – General Conditions

B. Section 01 33 00 – Submittal Procedures

C. Section 01 73 23 – Anchorage and Bracing of Non-Structural Components

D. Section 01 75 00 – Checkout and Startup Procedures

E. Section 07 90 00 – Joint Fillers, Sealants and Caulking

F. Section 09 90 00 – Painting

G. Section 40 05 00 – Basic Mechanical Requirements

1.04 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

08-28-2025

B. American Society of Mechanical Engineers (ASME):

1. A13.1-2023 – Scheme for Identification of Piping Systems

2. B16.11-2021 – Forged Fittings, Socket-Welding and Threaded

3. B16.22-2021 – Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings

4. B16.24-2021 – Cast Copper Alloy Pipe Flanges and Flanged Fittings: Classes 150, 300, 600, 900, 1500, and 2500

5. B16.51-2021 – Copper and Copper Alloy Press-Connect Fittings

6. ASME Boiler and Pressure Vessel Code

7. BPVC Section IX-2015 Welding, Brazing, and Fusing Qualifications

C. American Society of Sanitary Engineers (ASSE):

1. 1010-2021 – Performance Requirements for Water Hammer Arresters

D. American Society for Testing and Materials (ASTM):

1. B32-2020 – Standard Specification for Solder Metal

2. B43-2020 – Standard Specification for Seamless Red Brass Pipe, Standard Sizes

3. B75/B75M-2011 – Standard Specification for Seamless Copper Tube

4. B88-2020 – Standard Specification for Seamless Copper Water Tube

5. B584-2022 – Standard Specification for Copper Alloy Sand Castings for General Applications

6. B687-1999 (R2016) – Standard Specification for Brass, Copper, and Chromium-Plated Pipe Nipples

E. American Welding Society (AWS):

1. A5.8M/A5.8-2019 – Specification for Filler Metals for Brazing and Braze Welding

F. International Code Council (ICC):

1. IPC (Latest Adopted) – International Plumbing Code

G. Manufacturers Specification Society (MSS):

1. SP-58-2018 – Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation

2. SP-110-2010 – Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends

H. NSF International (NSF):

1. 61-2024 – Drinking Water System Components – Health Effects

2. 372-2024 – Drinking Water System Components – Lead Content

1.05 SUBMITTALS

A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 00 – Submittal Procedures.

B. Product Data: For each type of product indicated.

C. Shop Drawings: Diagram power, signal, and control wiring.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For domestic water piping specialties and equipment to include operation and maintenance manuals.

1.06 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. NSF Compliance:

1. Comply with NSF 61, Drinking Water System Components – Health Effects; Sections 1 through 9.

2. Comply with NSF 372, Drinking Water System Components – Lead Content

PART 2 – PRODUCTS

2.01 COPPER TUBE AND FITTINGS

A. Soft Copper Tube: ASTM B 88, Type K (ASTM B 88M, Type A) water tube, annealed temper. Suitable for below ground use.

1. Copper, Solder-Joint Fittings: ASME B16.18, cast-copper-alloy, or ASME B16.22, wrought-copper, solder-joint pressure type. Furnish only wrought-copper fittings if indicated.

B. Hard Copper Tube: ASTM B 88, Type K (ASTM B 88M, Type A, water tube, drawn temper. Suitable for above ground use.

1. Copper, Solder-Joint Fittings: ASME B16.18, cast-copper-alloy, or ASME B16.22, wrought-copper, solder-joint pressure type. Furnish only wrought-copper fittings if indicated.

C. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end.

D. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

2.02 SOLDER AND FLUX FOR POTABLE WATER SYSTEMS

A. Solder and flux for water distribution systems intended for human consumption shall conform to NSF-61. Solder shall be certified to NSF-61.

2.03 BACKFLOW PREVENTERS

A. Reduced-Pressure-Principle Backflow Preventers:

1. Manufacturers:

a. Conbraco Industries, Inc.

b. FEBCO; SPX Valves & Controls.

c. Watts Industries, Inc.; Water Products Div.

d. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1013.

3. Operation: Continuous-pressure applications.

4. Pressure Loss: 12 psig maximum, through middle 1/3 of flow range.

5. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved or steel with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.

6. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.

7. Configuration: Designed for horizontal, straight through flow.

8. Accessories:

   a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 and smaller; outside screw and yoke gate-type with flanged ends on inlet and outlet of NPS 2-1/2 and larger.

   b. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

2.04 HOSE BIBBS

A. Hose Bibbs:

1. Standard: ASME A112.18.1 for faucets.

2. Body Material: Bronze.

3. Seat: Bronze, replaceable.

4. Supply Connections: NPS 3/4 threaded or solder-joint inlet.

5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.

6. Pressure Rating: 125 psig.

7. Vacuum Breaker: Integral nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.

2.05 WASHDOWN HOSING FOR HOSE BIBBS

A. Furnish and install 75 feet of washdown hosing at each new hose bibb and rack locations.

B. Hosing shall meet the following requirements:

1. ¾-inch inside diameter fiber reinforced EPDM hose tube and cover material with maximum working pressure of 300 psi at 70 deg F with a burst pressure of 1,200 psi (4:1 safety factor). Hosing shall have antimicrobial properties and comply with applicable FDA and USDA standards.

2. ¾-inch brass hose fittings (MGHT x FGHT) preassembled to hose.

3. Hosing outer cover color shall be white.

2.06 EMERGENCY SHOWER/EYEWASH STATIONS

A. Combination shower and eyewash stations shall be installed where shown on the Contract Drawings.

B. For exterior shower/eyewash units, the drench shower and the eyewash shall be operated independently by hand actuated flag type handles or push down plates that remain open until manually closed. All exterior shower/eyewash stations shall be Halo Model S19314UU as manufactured by Bradley, Model 8300 as manufactured by Haws, or equal. Dual automatic pressure compensation devices shall provide steady water flow under pressures varying from 30 to 75 psi.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Refer to Section 40 05 00 - Basic Mechanical Requirements for piping joining materials, joint construction, and basic installation requirements.

B. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.

1. For indoor installations, install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer.

2. Do not install bypass piping around backflow preventers.

C. Emergency shower/eyewash stations shall be installed where shown on the Drawings or as directed by the Engineer. Where required by OSHA regulations, the background of the mounting location shall be painted the appropriate color.

3.02 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 and Division 40 Sections. Drawings indicate general arrangement of piping and specialties.

B. Ground equipment according to Section 26 05 26 – Grounding and Bonding for Electrical Systems.

C. Connect wiring according to Section 26 05 19 – Low-Voltage Conductors and Cables.

3.03 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:

1. Pressure vacuum breakers.

2. Intermediate atmospheric-vent backflow preventers.

3. Reduced-pressure-principle backflow preventers.

4. Double-check backflow-prevention assemblies.

5. Automatic balancing valves.

6. Outlet boxes.

7. Supply-type, trap-seal primer valves.

B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 40 05 97 – Piping and Equipment Identification Systems.

3.04 FIELD QUALITY CONTROL

A. Perform the following tests and prepare test reports:

1. Test each pressure vacuum breaker reduced-pressure-principle backflow preventer, double-check backflow-prevention assembly and vacuum breaker assembly according to authorities having jurisdiction and the device's reference standard.

B. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

3.05 TESTS

A. General: Test system either in its entirety or in sections. Submit testing plan to Owner’s Representative 10 working days prior to test date.

B. Potable Water System: Test after installation of piping and domestic water heaters, but before piping is concealed, before covering is applied, and before plumbing fixtures are connected. Fill systems with water and maintain hydrostatic pressure of 150 psig gauge for two hours. No decrease in pressure is allowed. Provide a pressure gauge with a shutoff and bleeder valve at the highest point of the piping being tested. Pressure gauge shall have 1 psig increments.

C. All Other Piping Tests: Test new installed piping under 1-1/2 times actual operating conditions and prove tight.

D. The test pressure shall hold for the minimum time duration required by the applicable plumbing code or authority having jurisdiction.

3.06 ADJUSTING

A. Confirm flow rate and direction of flow for automatic balancing valves.

END OF SECTION

DIVISION 26 – ELECTRICAL

SECTION 26 05 00
BASIC ELECTRICAL REQUIREMENTS

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish all labor, materials, tools, and equipment, and perform all work and services necessary for, or incidental to, the furnishing and installation of all electrical work as shown on the Drawings, and as specified in accordance with the provisions of the Contract Documents and completely coordinate with the work of other trades involved in the general construction. Although such work is not specifically shown or specified, all supplementary or miscellaneous items, appurtenances, and devices incidental to or necessary for a sound, secure, and complete installation shall be furnished and installed as part of this work. The Contractor shall obtain approved Shop Drawings showing wiring diagrams, connection diagrams, roughing-in, and hook up details for all equipment and comply therewith. All electrical work shall be complete and left in operating condition in accordance with the intent of the Drawings and the Specifications for the electrical work.

B. Reference Section 40 61 13 – Process Control System General Provisions in Division 01 for scope of work details as they relate to the Division 40 Instrumentation and Control System Subcontractor.

C. The electrical scope of work for this project primarily includes, but is not limited to, the following:

1. Modifications to existing electrical equipment as shown on the Drawings and as specified herein.

2. Furnish and install low voltage motor control equipment.

3. Furnish and install power and lighting panelboards, dry-type transformers, and other low voltage electrical power distribution equipment.

4. Furnish and install all aboveground raceway systems including conduit, fittings, boxes, supports, and other pertinent components.

5. Furnish and install all underground raceway systems including conduit, fittings, manholes, handholes and other pertinent components.

6. Furnish and install all low voltage wire and cable resulting in a complete and operable electrical system.

7. Furnish and install new lighting systems and wiring devices.

8. Furnish and install facility grounding systems where specified or indicated on the Drawings.

9. Furnish and install instrumentation conduits and wiring where specified or indicated on the Drawings and coordinated with the instrumentation drawings and specifications.

10. Other electrical work as specified herein and indicated on the Drawings.

D. All material and equipment shall be the product of an established, reputable, and approved manufacturer; shall be new and of first-class construction; shall be designed and guaranteed to perform the service required; and shall bear the Label of approval of the Underwriters Laboratories, Inc., where such approval is available for the product of the listed manufacturer as approved by the Engineer.

E. When a specified or indicated item has been superseded or is no longer available, the manufacturer's latest equivalent type or model of material or equipment as approved by the Engineer shall be furnished and installed at no additional cost to the Owner.

F. Where the Contractor's selection of equipment of specified manufacturers or additionally approved manufacturers requires changes or additions to the system design, the Contractor shall be responsible in all respects for the modifications to all system designs, subject to approval of the Engineer. The Contractor's bid shall include all costs for all work of the Contract for all trades made necessary by such changes, additions or modifications or resulting from any approved substitution.

G. Furnish and install all stands, racks, brackets, supports, and similar equipment required to properly serve the equipment which is furnished under this Contract, or equipment otherwise specified or indicated on the Drawings.

H. All electrical components and systems (e.g., conduit and other raceways, freestanding equipment, etc.) and their anchorage, including electrical equipment foundations, shall be designed to resist the controlling load combination of gravity loads, operational forces, wind forces, thermal loads, and any other applicable forces required in accordance with the governing Building Code.

1.02 EQUIPMENT LOCATION

A. The Drawings show the general location of feeders, transformers, equipment, devices, conduits, and circuit arrangements. Because of the small scale of the Drawings, it is not possible to indicate all of the details involved. The Contractor shall carefully investigate the structural and finish conditions affecting the work and shall arrange such work accordingly. The Contractor shall furnish and install such fittings, junction boxes, and

accessories as may be required to meet such conditions. The Contractor shall refer to the entire Drawing set to verify openings, special surfaces, and location of other equipment, or other special equipment prior to roughing-in for panels, switches, and other outlets. The Contractor shall verify all equipment dimensions to ensure that the proposed equipment will fit properly in spaces indicated.

B. Where outlets are shown near identified equipment furnished by this or other Contractors, it is the intent of the Specifications and Drawings that the outlet be located at the equipment to be served. The Contractor shall coordinate the location of these outlets to be near the final location of the equipment served regardless of where indicated on the Drawings.

1.03 LOCAL CONDITIONS

A. The Contractor shall examine the site and become familiar with conditions affecting the work. The Contractor shall investigate, determine, and verify locations of any overhead or buried utilities on or near the site, and shall determine such locations in conjunction with all public and/or private utility companies and with all authorities having jurisdiction (AHJs). All costs, both temporary and permanent to connect all utilities, shall be included in the Bid. The Contractor shall be responsible for scheduling and coordinating with the local utility for temporary and permanent services.

B. In addition, the Contractor shall relocate all duct banks, lighting fixtures, receptacles, switches, boxes, and other electrical equipment as necessary to facilitate the Work included in this project. Costs for such work shall be included in the Bid.

1.04 SUBMITTALS

A. In accordance with the procedures and requirements set forth in Section 01 33 00 – Submittal Procedures and the requirements of the individual Specification Sections, the Contractor shall obtain from the equipment manufacturer and submit the following:

1. Shop Drawings
2. Operation and Maintenance Manuals
3. Supplier Recommended Spare Parts List
4. Spare Parts Provided
5. Proposed Testing Methods and Reports of Certified Shop Tests
6. Reports of Certified Field Tests
7. Manufacturer’s Representative’s Certification

B. Submittals shall be sufficiently complete in detail to enable the Engineer to determine compliance with Contract requirements.

C. Submittals will be approved only to the extent of the information shown. Approval of an item of equipment shall not be construed to mean approval for components of that item for which the Contractor has provided insufficient information.

D. Some individual electrical specification sections may require a Compliance, Deviations, and Exceptions (CD&E) letter to be submitted. If the CD&E letter is required and shop drawings are submitted without the letter, the submittal will be rejected. The letter shall include all comments, deviations, and exceptions taken to the Drawings and Specifications by the Contractor AND Equipment Manufacturer/Supplier. This letter shall include a copy of the applicable specification section(s). In the left margin beside each paragraph/item, a letter "C", "D", or "E" shall be typed or written in. The letter "C" shall be for full compliance with the requirement. The letter "D" shall be for a deviation from the requirement. The letter "E" shall be for taking exception to a requirement. Any requirements with the letter "D" or "E" beside them shall be provided with a full typewritten explanation of the deviation/exception. Handwritten explanation of the deviations/exceptions is not acceptable. The CD&E letter shall also address deviations and exceptions taken to each Drawing related to the applicable specification section(s).

E. Submit design for all nonstructural electrical components and systems and their anchorage in accordance with the governing Building Codes.

1.05 APPLICABLE CODES AND REQUIREMENTS

A. Conformance

1. Unless otherwise noted, all work, equipment, and materials furnished shall conform with the latest available version of the rules, requirements, and specifications of the following:

a. Insurance Rating Organization having jurisdiction.

b. The electric utility company.

c. The currently adopted edition of the National Electrical Code (NEC).

d. The National Electric Manufacturers Association (NEMA).

e. The Institute of Electrical and Electronic Engineers (IEEE).

f. The Insulated Cable Engineers Association (ICEA).

g. The American Society of Testing Materials (ASTM).

h. The American National Standards Institute (ANSI).

i. The requirements of the Occupational Safety Hazards Act (OSHA).

j. The National Electrical Contractors Association (NECA) Standard of Installation.

k. National Fire Protection Association (NFPA).

l. InterNational Electrical Testing Association (NETA).

m. All other applicable Federal, State/Commonwealth, and local laws and/or ordinances.

n. The NECA standard, latest version, for Good Workmanship in Electrical Construction

2. All equipment and materials shall be Listed by and shall bear the Label of Underwriter's Laboratories, Incorporated (UL), if the material and equipment is of the type/class inspected by said laboratories.

B. Nonconformance

1. Any paragraph of requirements in these Specifications or Drawings deviating from the rules, requirements, and specifications of the above organizations shall be invalid and their (the above organizations) requirements shall hold precedent thereto. The Contractor shall be held responsible for adherence to all rules, requirements, and specifications as set forth above. Any additional work or material necessary for adherence will not be allowed as an extra but shall be included in the Bid. Ignorance of any rule, requirement, or specification shall not be allowed as an excuse for nonconformity. Acceptance by the Engineer does not relieve the Contractor from the expense involved for the correction of any errors which may exist in the drawings submitted or in the satisfactory operation of any equipment.

C. Certification

1. Where applicable, upon completion of the work, the Contractor shall obtain certificate(s) of inspection and approval from the inspection organization having jurisdiction and shall deliver same to the Engineer and the Owner.

1.06 PERMITS AND INSPECTIONS

A. The Contractor shall reference the General Conditions and Section 01 11 00 – Summary of Work.

1.07 TEMPORARY LIGHTING AND POWER

A. The Contractor shall reference the General Conditions and Section 01 51 00 – Temporary Utilities.

1.08 TESTS

A. Upon completion of the installation, the Contractor shall perform tests for operation, load (Phase) balance, overloads, and short circuits. Tests shall be made with and to the satisfaction of the Owner and Engineer.

B. The Contractor shall perform all field tests and shall provide all labor, equipment, and incidentals required for testing and shall pay for electric power required for the tests. All defective material and workmanship disclosed shall be corrected by the Contractor at no cost to the Owner. The Contractor shall show by demonstration in service that all circuits and devices are in good operating condition. Test shall be such that each item of control equipment will function not less than five (5) times.

C. Refer to each individual specification section for detailed test requirements.

D. The Contractor shall complete the installation and field testing of the electrical installation prior to the start-up and testing of any equipment served by that electrical equipment. During the period between the completion of electrical installation and the start-up and testing of all other equipment, the Contractor shall make all components of the Work available as it is completed for their use in performing Preliminary and Final Field Tests.

E. Before each test commences, the Contractor shall submit a detailed test procedure, and also provide test engineer resume, personnel, and scheduling information for approval by the Engineer. In addition, the Contractor shall furnish detailed test procedures for any electrical equipment required as part of the field tests of other systems.

1.09 INFRARED INSPECTION

A. Just prior to the final acceptance of a piece of equipment, the Contractor shall perform an infrared inspection to locate and correct all heating problems associated with electrical equipment terminations. The infrared inspection shall be performed by a qualified, independent, third-party testing company, not the Electrical Contractor.

B. Equipment located in hazardous areas shall be excluded from infrared testing requirements since the equipment in those areas is not intended to be operated while the enclosure is open. The infrared inspection shall apply to all new equipment and existing equipment in non-hazardous areas that is in any way modified under this Contract. All heating problems detected with new equipment furnished and installed under the Scope of this Contract shall be corrected by the Contractor at no additional

cost to the Owner. All problems detected with portions of existing equipment modified under this Contract shall also be corrected by the Contractor at no additional cost to the Owner.

C. Any issues detected with portions of existing equipment that were not modified under this Contract are not the responsibility of the Contractor. Despite the Contractor not being held responsible for these problems, the Contractor shall report them to the Owner and Engineer immediately for resolution.

D. The infrared inspection report shall include both digital photos and infrared (IR) photos positioned side by side. Both digital and IR photos shall be clear and high quality. Fuzzy, grainy, or poorly illuminated photos are not acceptable. Each IR photo shall be provided with a temperature scale beside it, and an indication of the hot spot temperature in the photo and another photo showing the same hotspot location after correction of condition causing the hotspot. Reports shall be furnished in a 3-ring binder, with all pages printed in full color, with equipment assemblies separated by tabs.

1.10 SCHEDULES AND FACILITY OPERATIONS

A. Since the equipment testing required herein shall require that certain pieces of equipment be taken out of service, all testing procedures and schedules shall be submitted to the Engineer for review and approval one (1) month prior to any work beginning. When testing has been scheduled, the Engineer shall be notified 48 hours prior to any work to allow time for load switching and/or alternation of equipment. In addition, all testing that requires temporary shutdown of facility equipment shall be coordinated with the Owner/Engineer so as not to affect proper facility operations.

B. At the end of the workday, all equipment shall be back in place and ready for immediate use should a facility emergency arise. In addition, should an emergency condition occur during testing, at the request of the Owner, the equipment shall be placed back in service immediately and turned over to Owner personnel.

C. In the event of accidental shutdown of Owner equipment, the Contractor shall notify Owner personnel immediately to allow for an orderly restart of affected equipment.

D. Maintaining the operation of these facilities during the duration of the construction period is essential and required. The Contractor shall furnish and install temporary equipment as required to maintain facility operation. Reference Section 01 14 00 – Coordination with Owner’s Operations for construction sequencing and specific operational constraint information.

1.11 EQUIPMENT, MATERIALS, AND SPARE PARTS HANDLING AND STORAGE

A. Materials arriving on the job site shall be stored in such a manner as to keep material free of water, rust, dirt, and to keep material properly aligned and true to shape. Rusty,

dirty, or misaligned material will be rejected. Electrical conduit shall be stored to provide protection from the weather and accidental damage. Rigid non-metallic conduit shall be stored on even supports and in locations not subject to direct sun rays or excessive heat. Cables shall be sealed, stored, and handled carefully to avoid damage to the outer covering or insulation and damage from moisture and weather. Adequate protection shall be required at all times for electrical equipment and accessories until installed and accepted. Materials damaged during shipment, storage, installation, or testing shall be replaced or repaired in a manner meeting with the approval of the Engineer. If space heaters are provided in a piece of electrical equipment, they shall be temporarily connected to a power source during storage. The Contractor shall store equipment and materials in accordance with Section 01 55 00 – Contractor Access and Parking.

B. Spare parts lists, included with the shop drawing submittal for each Section, shall indicate specific sizes, quantities, and part numbers of the items to be furnished. Terms such as "1 lot of packing material" are not acceptable.

C. Spare parts shall be completely identified with a numerical system to facilitate parts inventory control and stocking. Each part shall be properly identified by a separate number. Those parts which are identical for more than one size, shall have the same parts number.

D. Spare parts shall be packed in containers suitable for long-term storage, bearing labels clearly designating the contents and the pieces of equipment for which they are intended.

E. Spare parts shall be delivered at the same time as the equipment to which they pertain. The Contractor shall properly store and safeguard such spare parts until completion of the work, at which time they shall be delivered to the Owner.

1.12 WARRANTIES

A. Unless otherwise specified in an individual specification section, all electrical equipment and electrical construction materials shall be provided with a warranty in accordance with the requirements of Section 46 00 00 – Equipment General Provisions and the General Conditions.

1.13 TRAINING

A. Unless otherwise specified in an individual specification section, all training for electrical equipment shall be provided in accordance with the requirements of Section 46 00 00 – Equipment General Provisions.

PART 2 – PRODUCTS

2.01 PRODUCT REQUIREMENTS

A. Unless otherwise indicated, the materials to be provided under this Specification shall be the products of manufacturers regularly engaged in the production of all such items and shall be the manufacturer's latest design. The products shall conform to the applicable standards of UL and NEMA, unless specified otherwise.

B. All items of the same type or ratings shall be identical. This shall be further understood to include products with the accessories indicated.

C. All equipment and materials shall be new, unless indicated or specified otherwise.

D. The Contractor shall submit proof if requested by the Engineer that the materials, appliances, equipment, and/or devices that are provided under this Contract meet the requirements of Underwriters Laboratories, Inc. with regard to fire and casualty hazards. Documentation indicating Listing and Labeling by Underwriters Laboratories, Inc., will be accepted as meeting this requirement.

E. Where the above items are Labeled by (bearing the certification mark of) an OSHA Nationally Recognized Testing Laboratory (NRTL) other than UL, and the NRTL is authorized by the Occupational Safety and Health Administration (OSHA) to test and certify those items to the same standard(s), then the certification mark of that NRTL shall be considered equivalent to the ‘UL’ certification mark.

2.02 SUBSTITUTIONS

A. Unless specifically noted otherwise, any reference in the Specifications or on the Drawings to any article, service, product, material, fixture, or item of equipment by name, make, or catalog number shall be interpreted as establishing the type, function, and standard of quality and shall not be construed as limiting competition. The Contractor, in such cases may use any article, device, product, material, fixture, or item of equipment which in the judgment of the Engineer, expressed in writing, is equal to that specified.

2.03 CONCRETE

A. The Contractor shall furnish all concrete required for the installation of all electrical work. Concrete shall be Class A unless otherwise specified. Concrete and reinforcing steel shall meet the appropriate requirements of Division 03 of the Specifications.

B. The Contractor shall provide concrete equipment pads for all free-standing electrical apparatus and equipment located on new or existing floors or slabs. The Contractor shall provide all necessary anchor bolts, channel iron sills, and other materials as required. The exact location and dimensions shall be coordinated for each piece of equipment well in advance of the scheduled placing of these pads. Equipment pads shall be 4 inches

high unless otherwise indicated on the Drawings and shall conform to the Standard Detail for equipment pads shown on the Drawings. Equipment pads shall not have more than 3 inches of excess concrete beyond the edges of the equipment.

C. The Contractor shall provide concrete foundations for all free-standing electrical apparatus and equipment located outdoors or where floors or slabs do not exist and/or are not or provided by others under this Contract. The Contractor shall provide all necessary anchor bolts, channel iron sills, and other materials as required. The location and dimensions shall be coordinated for each piece of equipment well in advance of the scheduled placing of the foundations. Equipment foundations shall be constructed as detailed on the Drawings or if not detailed on the Drawings shall be 6 inches thick minimum reinforced with #4 bars at 12-inch centers each way placed mid-depth. Concrete shall extend 6 inches minimum beyond the extreme of the equipment base and be placed on a compacted stone bed (#57 stone or ABC) 6 inches thick minimum.

PART 3 – XECUTION

3.01 CUTTING AND PATCHING

A. Coordination

1. The Work shall be coordinated between all trades to avoid delays and unnecessary cutting, channeling, and drilling. Sleeves shall be placed in concrete for passage of conduit wherever possible.

B. Damage

1. The Contractor shall perform all chasing, channeling, drilling, and patching necessary to the proper execution of this Contract. Any damage to the building, structure, or any equipment shall be repaired by qualified mechanics of the trades involved at the Contractor's expense. If, in the Engineer's judgment, the repair of damaged equipment would not be satisfactory, then the Contractor shall replace damaged equipment at the Contractor’s expense.

C. Existing Equipment

1. Provide a suitable cover or plug for openings created in existing equipment as the result of work under this Contract. For example, provide round plugs in equipment enclosures where the removal of a conduit creates a hole and the enclosure. Covers and plugs shall maintain the NEMA rating of the equipment enclosure. Covers and plugs shall be watertight when installed in equipment located outdoors.

3.02 EXCAVATION AND BACKFILLING

A. The Contractor shall perform all excavation and backfill required for the installation of all electrical work. All excavation and backfilling shall be in complete accordance with the applicable requirements of Division 31 Earthwork.

3.03 CORROSION PROTECTION

A. Wherever dissimilar metals, except conduit and conduit fittings, come into contact, the Contractor shall isolate these metals as required with neoprene washers, nine (9) mil polyethylene tape, or gaskets.

END OF SECTION

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SECTION 26 05 19
LOW VOLTAGE CONDUCTORS AND CABLES

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish, install, connect, test, and place in satisfactory operating condition all low voltage wire and cable indicated on the Drawings, as specified herein, and/or required for proper operation. The work of connecting cables to equipment and devices shall be considered a part of this Section. All appurtenances required for the installation of wire and cable systems shall be furnished and installed by the Contractor.

B. The scope of this Section does not include internal wiring factory installed by equipment manufacturers.

C. Reference the following Specification Sections:

1. Section 26 05 00 – Basic Electrical Requirements

2. Section 26 05 33.16 – Boxes for Electrical Systems

1.02 CODES AND STANDARDS

A. All low voltage wire, cable, and appurtenances shall be Listed by and shall bear the Label of Underwriter's Laboratories, Incorporated (UL).

B. Low voltage wire, cable, and appurtenances shall be designed, manufactured, and/or Listed to the following standards as applicable:

1. American National Standards Institute (ANSI)/Institute of Electrical and Electronic Engineers (IEEE):

a. IEEE 1202 – Standard for Flame Testing of Cables.

2. American Society for Testing and Materials (ASTM):

a. ASTM B3 – Standard Specification for Soft or Annealed Copper Wire.

b. ASTM B8 – Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.

c. ASTM B33 – Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes.

d. ASTM D69 – Standard Test Methods for Friction Tapes.

e. ASTM D4388 – Standard Specification for Nonmetallic Semi-Conducting and Electrically Insulating Rubber Tapes.

3. Insulated Cable Engineers Association (ICEA):

a. ICEA S-58-679 – Standard for Control, Instrumentation and Thermocouple Extension Conductor Identification.

b. ICEA T-29-250 – Conducting Vertical Cable Tray Flame Tests with Theoretical Heat Input Rate of 210,000 B.T.U./Hour.

4. National Fire Protection Association (NFPA):

a. NFPA 70 – National Electrical Code (NEC).

5. Underwriters Laboratories (UL):

a. UL 13 – Standard for Power-Limited Circuit Cables.

b. UL 44 – Thermoset-Insulated Wires and Cables.

c. UL 83 – Thermoplastic-Insulated Wires and Cables.

d. UL 486A-486B – Standard for Safety Wire Connectors

e. UL 1277 – Standard for Electrical Power and Control Tray Cables with Optional Optical-Fiber Members.

f. UL 1581 – Reference Standard for Electrical Wires, Cables, and Flexible Cords.

g. UL 1685 – Standard for Vertical-Tray Fire-Propagation and Smoke-Release Test for Electrical and Optical-Fiber Cables.

h. UL 2250 – Standard for Instrumentation Tray Cable.

i. UL 2556 – Wire and Cable Test Methods.

1.03 SUBMITTALS

A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01 33 00 – Submittal Procedures, the Contractor shall obtain from the wire and cable manufacturer and submit the following:

1. Shop Drawings

2. Reports of Field Tests Circuit Logs

B. Each submittal shall be identified by the applicable Specification Section.

1.04 SHOP DRAWINGS

A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed material's compliance with the Contract Documents.

B. Partial, incomplete, or illegible Submittals will be returned to the Contractor without review for resubmittal.

C. Shop drawings shall include but not be limited to:

1. Product data sheets for the following:

a. Wire and cable

1) The product data sheets for wire and cable for up to four (4) manufacturers for each type of wire/cable specified herein will be reviewed if they are submitted at the same time under the same submittal cover for simultaneous review.

b. Power and control wire terminations, including wire ferrules

c. Instrumentation cable terminations

d. Pulling lubricant.

2. Cable pulling calculations (if required).

3. Wiring identification methods and materials.

D. The shop drawing information shall be complete and organized in such a way that the Engineer can determine if the requirements of these specifications are being met. Copies of technical bulletins, technical data sheets from "soft-cover" catalogs, and similar information which is highlighted or somehow identifies the specific equipment items the Contractor intends to provide are acceptable and shall be submitted.

1.05 CABLE PULLING CALCULATIONS

A. Prior to the installation of the wire and cable specified herein, the Contractor shall submit cable pulling calculations for Engineer review and approval when all of the following are true:

1. The length of cable to be installed will be greater than 200 linear feet between pull points.

2. The installation will have two or more bends.

3. The wire/cable is size #1/0 AWG and larger.

B. Cable pulling calculations shall be performed by a Professional Engineer (P.E.) licensed in the State or Commonwealth in which the project is located. Calculations shall define pulling tension and sidewall loading (sidewall bearing pressure values).

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. The wire and cable to be furnished and installed for this project shall be the product of manufacturers who have been in the business of manufacturing wire and cable for a minimum of ten (10) years. Wire and cable shall be designed, constructed, and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as specified herein and indicated on the Drawings.

2.02 POWER AND CONTROL WIRE AND CABLE

A. Power wire for all loads at voltages greater than 240V shall be UL 44 Listed as NEC Type XHHW-2 insulated conductors stranded copper.

B. Power wire for all other loads at a voltage not greater than 240V and control wire shall consist of insulated copper conductors with a nylon (or equivalent) outer jacket. Conductor insulation shall be rated 90°C for dry locations, 75°C for wet locations, and 600V. Insulated power conductors shall be UL 83 Listed as NEC Type XHHW.

C. Unless specified otherwise herein, conductors shall be stranded copper per ASTM B-8 and B-3, with Class B or C stranding contingent upon the size. Power conductors for lighting and receptacle branch circuits shall be solid copper per ASTM B-3.

D. Power conductor minimum size shall be No. 12 AWG and Control conductors minimum size shall be No. 14 AWG.

E. Multi-conductor cable assemblies shall include a grounding conductor and an overall PVC jacket. The jacket shall be PVC and resistant to abrasion, sunlight, and flame in accordance with UL 1277. Multi-conductor cable assemblies shall be UL 1277 Listed as NEC Type TC (Power and Control Tray Cable).

F. Power wire and cable shall be as manufactured by the Okonite Company, the Southwire Company, General Cable, Encore Wire, or Engineer approved equal.

2.03 INSTRUMENTATION CABLE

A. For single-analog signal applications, instrumentation cable shall consist of a single, twisted pair or triad of individually insulated and jacketed copper conductors with an overall cable shield and jacket. Conductor insulation shall be rated 90°C in both wet and dry locations, and 600V. The jacket shall be PVC and resistant to abrasion, sunlight, and flame in accordance with UL 1277. Cable shall be UL 1277 Listed as NEC Type TC (Power and Control Tray Cable).

B. For multiple-analog signal applications, instrumentation cable shall consist of multiple, twisted pairs or triads (i.e., groups) of individually insulated and jacketed copper conductors with individual pair/triad shields (i.e., group shields) and an overall cable shield and jacket. Conductor insulation shall be rated 90°C in both wet and dry locations, and 600V. The jacket shall be PVC and resistant to abrasion, sunlight, and flame in accordance with UL 1277. Cable shall be UL 1277 Listed as NEC Type TC (Power and Control Tray Cable).

C. Cable and group shields shall consist of overlapped aluminum/polyester tape/foil providing 100% coverage. Instrumentation cables shall include an overall copper shield drain wire. Cables containing multiple twisted pairs or triads shall also include group shield drain wires.

D. Conductors, including drain wires, shall be tin or alloy coated (if available), soft, annealed copper, stranded per ASTM B-8, with Class B stranding unless otherwise specified.

E. Instrumentation signal conductor size shall be no smaller than No. 16 AWG.

F. Instrumentation cable shall be Okoseal-N Type P-OS (for single pair or triad applications) or Okoseal-N Type SP-OS (for multiple pair or triad applications) as manufactured by the Okonite Company, Belden equivalent, Southwire Company equivalent, or Engineer approved equal.

2.04 SHIELDED VFD CABLE (NOT USED FOR THIS PROJECT)

A. Where indicated on the Drawings, shielded VFD cable shall be installed between the output terminals of a VFD and the respective motor.

B. Shielded VFD cable shall consist of three (3) individually insulated copper phase conductors and three (3) bare copper grounding conductors with an overall cable shield and jacket, suitable for use with variable frequency drives. The phase conductors and ground conductors shall be symmetrically arranged within the cable assembly. Conductor insulation shall be rated 90°C in both wet and dry locations, and 2000V (2kV). Insulated conductors shall be UL Listed as NEC Type RHW-2 or XHHW-2. The jacket shall be PVC and resistant to abrasion, sunlight, and flame in accordance with UL 1277. Cable shall be UL Listed as NEC Type TC-ER (Tray Cable for Exposed Runs).

C. Phase conductors shall be sized as shown on the Drawings. Ground conductors shall have a combined circular mil area equivalent to the equipment grounding conductor size required by NEC Table 250.122, minimum. Filler material shall be included in the cable assembly as necessary to make the cable round.

D. Cable shields shall consist of a helically applied bare copper tape with 50% overlap, minimum. For small conductor sizes where copper tape shields are not available, shields shall be permitted to consist of a layer of tin-coated copper braid covered by a layer of overlapped aluminum/polyester tape/foil. All cable shields shall provide 100% coverage.

E. Conductors shall be annealed, tinned, stranded copper per ASTM B3, B8, and B33.

F. Shielded VFD cable shall be as manufactured by Belden Wire and Cable, the Okonite Company, General Cable, Southwire, or AmerCable Inc.

2.05 OTHER CABLES

A. Category 6 UTP communication cables and fiber optic cables shall be as specified in Specification Section 40 66 00 – Network and Communication Equipment.

2.06 CONDUCTOR IDENTIFICATION

A. Conductors shall be identified using a color-coding method. Color coding for individual power, control, lighting, and receptacle conductors shall be as follows:

1. 480/277V AC Power

    a. Phase A – BROWN

    b. Phase B – ORANGE

    c. Phase C – YELLOW

    d. Neutral – GREY

2. 120/208V or 120/240V AC Power

a. Phase A – BLACK

b. Phase B – RED

c. Phase C – BLUE

d. Neutral – WHITE

3. DC Power

a. Positive Lead – RED

b. Negative Lead - BLACK

4. DC Control

a. All wiring – BLUE

5. 120 VAC Control

a. 120 VAC control wire shall be RED except for a wire entering a motor control center compartment, motor controller, or control panel which is an interlock. This interlock conductor shall be color coded YELLOW. For the purposes of this Section, an interlock is defined as any wiring that brings voltage into the above-mentioned equipment from a source outside that equipment.

b. A 240V, 3 phase system, mark the high leg orange.

6. 24 VAC Control

a. All wiring - ORANGE

7. Equipment Grounding Conductor

a. All wiring - GREEN

B. Individual conductors No. 2 AWG and smaller shall have factory color coded insulation. It is acceptable for individual conductors larger than No.2 AWG to be provided with factory color coded insulation as well, but it is not required. Individual conductors larger than No.2 AWG that are not provided with factory color coded insulation shall be identified using colored tape in accordance with the requirements listed in Part 3 herein. Insulation colors and tape colors shall be in accordance with the color-coding requirements listed above.

C. Conductors that are part of multi-conductor cable assemblies shall have black insulation. The conductor's number shall be printed on each conductor's insulation in accordance

with ICEA S-58-679, Method 4. Each conductor No.2 AWG and smaller within the cable assembly shall also be identified with a heat shrink tag with color coded background. Each conductor larger than No.2 AWG within the cable assembly shall also be identified by the use of colored tape. Heat shrink tags and colored tape shall be in accordance with the requirements listed in Part 3 herein. Tape color and heat shrink tag background color shall be in accordance with the color-coding requirements listed above.

2.07 CABLE PULLING LUBRICANTS

A. Cable pulling lubricants shall be non-hardening type and approved for use on the type of cable installed. Lubricant shall be Yellow #77 Plus by Ideal, Cable Gel by Greenlee, Poly-Gel by Gardner Bender, or equal.

PART 3 – EXECUTION

3.01 WIRE AND CABLE INSTALLATION

A. General

1. All wire and cable furnished under this Contract, including wire and cable furnished under other Divisions, shall be installed in raceways (e.g., conduit) unless specifically noted otherwise.

2. Wire and cable shall be installed as specified herein and indicated on the Drawings. Unless specifically indicated otherwise on the Drawings, wire and cable shall be installed in separate raceways according to wiring type. For example, power wiring shall not be combined with control wiring, and control wiring shall not be combined with instrumentation wiring.

3. Wire shall be furnished and installed as single conductor cables, with limited exceptions. Multi-conductor cable assemblies shall only be installed where indicated on the Drawings, required by the NEC, or after obtaining written permission from the Engineer.

4. Where instrumentation cables are installed in control panels, motor controllers, and other locations, the Contractor shall arrange wiring to provide maximum clearance between these cables and power conductors. Instrumentation cables shall not be installed in the same bundle with conductors of other circuits.

5. Instrumentation cable shielding shall be continuous and shall be grounded at one point only.

B. Splices

1. Splices shall not be allowed in power or control wire and cable unless approved in writing by the Engineer. If unique field conditions exist or pulling calculations indicate that splices may be required, the Contractor shall submit a detailed request indicating why splices are required to the Engineer. The Engineer shall be under no obligation to grant such request.

2. Splicing materials shall be UL 486A Listed barrel type butt splice connectors and heat shrink tubing as manufactured by 3M, Ideal, or equal. The use of screw-on wire connectors (wire nuts) shall only be permitted for lighting and receptacle circuits.

3. No splicing of instrumentation cable is permitted.

C. Wire and Cable Sizes

1. The sizes of wire and cable shall be as indicated on the Drawings, or if not shown, as approved by the Engineer. If required due to field routing, the size of conductors and respective conduit shall be increased so that the voltage drop measured from source to load does not exceed 3%.

D. Additional Conductor Identification

1. In addition to the color-coding identification requirements specified in Part 2 herein, individual conductors shall be provided with heat shrinkable identification tags. Identification tags for individual conductors shall have a white background where the conductor insulation is colored. Identification tags for individual conductors shall have a colored background where the conductor insulation is black. Background color shall match that of the taping provided on the individual black conductors.

2. Multi-conductor cables shall be provided with heat shrinkable identification tags in accordance with Part 2 herein.

3. All wiring shall be identified at each point of termination. This includes but is not limited to identification at the source, load, and in any intermediate junction boxes where a termination is made. The Contractor shall meet with the Owner and Engineer to come to an agreement regarding a wire identification system prior to installation of any wiring. Wire numbers shall not be duplicated.

4. Wire identification shall be by means of a heat shrinkable sleeve with appropriately colored background and black text. Wire sizes #14 AWG through #10 AWG shall have a minimum text size of 7 points. Wire sizes #8 AWG and larger shall have a minimum text size of 10 points. Sleeves shall be of appropriate length to fit the required text. The use of handwritten text for wire identification shall not be permitted.

5. Sleeves shall be suitable for the size of wire on which they are installed. Sleeves shall not be heat-shrunk onto control cables. Tags shall remain loose on cable to promote easier identification. For all other applications, sleeves shall be tightly affixed to the wire and shall not move. Sleeves shall be heat shrunk onto wiring with a heat gun approved for the application. Sleeves shall not be heated by any means which employs the use of an open flame. The Contractor shall take special care to ensure that the wiring insulation is not damaged during the heating process.

6. Sleeves shall be installed prior to the completion of the wiring terminations and shall be oriented so that they can be easily read.

7. Sleeves shall be polyolefin as manufactured by Brady, Seton, Panduit, or equal.

8. Wire identification in manholes, handholes, pull boxes, and other accessible components in the raceway system where the wiring is continuous (no terminations are made) shall be accomplished by means of a tag installed around the bundled group of individual conductors or around the outer conductor jacket of a multi-conductor cable. Identification shall utilize a FROM-TO system. Each group of conductors shall consist of all the individual conductors in a single conduit or duct. The tag shall have text that identifies the bundle in accordance with the 'FROM' and 'TO' column for that specific conduit number in the conduit and wire schedule. Minimum text size shall be 10 point. The tag shall be affixed to the wire bundle using nylon wire ties and shall be made of polyethylene as manufactured by Brady, Seton, Panduit, or equal.

9. Where colored tape is used to identify cables, it shall be wrapped around the cable with a 25% overlap and shall cover at least 2 inches of the cable.

E. Wiring Supplies

1. Rubber insulating tape shall be in accordance with ASTM D4388. Friction tape shall be in accordance with ASTM D69.

F. Training of Cable in Manholes, Handholes, and Vaults

1. The Contractor shall furnish all labor and material required to train cables around cable vaults, manholes, and handholes. Sufficient length of cable shall be provided in each handhole, manhole, and vault so that the cable can be trained and racked in an approved manner. In training or racking, the radius of bend of any cable shall be not less than the manufacturer's recommendation. The training shall be done in such a manner as to minimize chaffing.

2. Instrumentation cable shall be racked and bundled separate from AC wiring to maintain the required separation as follows:

a. 18 inches for 480/277 VAC wiring

b. 12 inches for 240/120 VAC wiring

c. 6 inches for 24 VAC wiring

G. Conductor Terminations

1. Where wires are terminated at equipment which requires lugs, connections shall be made by solderless mechanical lug, crimp type ferrule, or irreversible compression type lugs. Reference individual equipment Specification Sections as applicable for additional termination requirements.

2. For conductors with stranding other than Class B or C, a UL 486A Listed wire ferrule shall be installed prior to each conductor termination. Ferrules shall be suitable for the size of conductors and shall be made of a material that is compatible with the conductors. Ferrules shall be crimped on in accordance with the ferrule manufacturer's instructions.

3. Where enclosure sizes and sizes of terminals at limit switches, solenoid valves, float switches, pressure switches, temperature switches, and other devices make terminations impractical due to the size of the field wiring, the Contractor shall terminate field wiring in an adjacent junction box per the requirements of Section 26 05 33.16 – Boxes for Electrical Systems, complete with terminal strips. The Contractor shall install the smaller wiring from the device to the junction box in a conduit, using the terminal strip as the means for joining the two different wire sizes. Splicing of wires in lieu of using terminal strips is not acceptable.

4. The cables shall be terminated in accordance with the cable and/or termination product manufacturer's instructions for the particular type of cable.

5. To minimize oxidation and corrosion, selected wire and cable shall be terminated using an oxide-inhibiting joint compound recommended for electrical connections. The compound shall be Penetrox E for copper-to-copper connections, and Penetrox A for all other connections, as manufactured by Burndy Electrical, or equal. The joint compound shall be used in the following installations:

a. Terminations in all Class I and Class II, Division 1 and 2 hazardous areas.

6. All spare conductors shall be terminated on terminal blocks mounted within equipment or junction boxes. Unless otherwise noted, coiling up of spare conductors within enclosure is not acceptable.

H. Pulling Temperature

1. Cable shall not be installed when the temperature of the jacket is such that damage will occur due to low temperature embrittlement. When cables are pulled with an ambient temperature of 40°F or less within a three (3) day period prior to pulling, the cable reels shall be stored three (3) days prior to pulling in a protected storage area with an ambient temperature of 55°F or more. Cable pulling shall be completed during the workday for which the cable is removed from the protected storage. Any cable reels with wire remaining on them shall be returned to storage at the completion of the workday.

I. Circuit Log

1. The Contractor shall maintain a written log of installed circuit lengths for all single-phase and three-phase power circuits operating at 208VAC or greater. The log shall be organized in a tabular format, recording the following items for each circuit:

a. Circuit ID or Conduit ID(s) as shown on the Drawings.

b. From (originating equipment).

c. To (terminating equipment).

d. Conductor sizes and counts.

e. Conductor length.

3.02 TESTING

A. All testing shall be performed in accordance with the requirements of the General Conditions and Division 01. The following tests are required:

1. Shop Test

a. Wires and cables shall be tested in accordance with the applicable ICEA Standards. Wire and cable shall be physically and electrically tested in accordance with the manufacturer’s standards.

2. Field Tests

a. After installation, all wires and cables shall be tested for continuity. Testing for continuity shall be “test light” or “buzzer” style.

b. After installation, wires and cables shall be tested for insulation resistance levels between conductors of the same circuit and between conductor and ground as follows:

1) For #8 AWG and larger 600V wire and cable, apply 1,000 VDC from a Megohmmeter for one (1) minute. Resistance shall be no less than 100 Megohms.

2) Instrumentation signal cable shall be tested from conductor to conductor, conductor to shield, and conductor to ground using a Simpson No. 260 volt-ohmmeter or approved equal. The resistance value shall be 200 Megohms or greater.

3) Insulation resistance testing is not required for power and control cables smaller than #8 AWG.

c. Wires and cables shall be tested after required terminations are made, but before being connected to any equipment.

d. If tests reveal defects or deficiencies, the Contractor shall make the necessary repairs or shall replace the cable as directed by the Engineer, without additional cost to the Owner. All conductors of a multi-phase circuit shall be replaced if one conductor fails the required testing. If part of a multi-set (parallel conductors per phase) circuit fails testing, only the set containing failure shall be replaced.

e. All tests shall be made by and at the expense of the Contractor who shall supply all testing equipment. Test reports shall be submitted to the Engineer.

f.

Exhibit A
Test Data – Megohms
Test No. ____

Date:			Company:				
Time:			Location:				
Circuit:	Circuit Length:	Aerial:	Duct:	Buried:	No. of Conductors	Size:	AWG MCM Shield:
Insulation Material:			Insulation Thickness:		Voltage Rating:		Age:
Type: _____ Pothead _____ Terminal					Location: Indoors _____ Outdoors _____		
Number and Type of Joints:							
Recent Operating History:							
Manufacturer:							
State if Potheads or Terminals were grounded during test:							
List associated equipment included in test:							
Miscellaneous Information:							

Exhibit A
Test Data – Megohms
Test No. ____

Part Tested:	Test Performed: _____ Hours/Days: _____ After Shutdown: _____
Grounding Time:	Dry Bulb Temperature: _____ Wet Bulb Temperature: _____
Test Voltage:	Equipment Temperature: _____ How Obtained: _____ Relative Humidity: _____ Absolute Humidity: _____ Dew Point: _____

Megohmmeter: Serial Number: _____ Range: _____
Voltage: _____ Calibration Date: _____

Test Connections	To Line To Earth To Ground	To Line To Earth To Ground	To Line To Earth To Ground	Test Connections	To Line To Earth To Ground	To Line To Earth To Ground	To Line To Earth To Ground
1/4 Minute				5 Minutes			
1/2 Minute				6 Minutes			
3/4 Minute				7 Minutes			
1 Minute				8 Minutes			
2 Minutes				9 Minutes			
3 Minutes				10 Minutes			
4 Minutes				10/1 Minute Ratio			

Remarks:

END OF SECTION

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SECTION 26 05 26

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish and install grounding systems complete in accordance with the requirements established by Article 250 of the NEC. Article 250 of the NEC shall be considered a minimum requirement for compliance with this Specification.

B. Grounding of all instrumentation and control systems shall be furnished and installed in accordance with the manufacturer/system requirements and IEEE 1100. Conflicts shall be promptly brought to the attention of the Engineer.

C. In addition to the NEC requirements, building structural steel columns and metallic storage tanks shall be permanently and effectively grounded:

D. Reference Section 26 05 00 – Basic Electrical Requirements

1.02 CODES AND STANDARDS

A. Equipment and materials covered under this Section shall be designed, manufactured, and/or Listed to the following standards as applicable:

1. American National Standards Institute (ANSI)/Institute of Electrical and Electronic Engineers (IEEE):

    a. IEEE 81 – Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System.

    b. IEEE 1100 – Recommended Practice for Power and Grounding Electronic Equipment.

2. National Fire Protection Association (NFPA):

    a. NFPA 70 – National Electrical Code (NEC).

3. Underwriters Laboratories (UL):

    a. UL 467 – Grounding and Bonding Equipment.

1.03 SUBMITTALS

A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01 33 00 – Submittal Procedures, the Contractor shall obtain from the equipment manufacturer and submit the following:

1. Shop Drawings

2. Reports of certified field tests.

B. Each submittal shall be identified by the applicable Specification Section.

1.04 SHOP DRAWINGS

A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.

B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for resubmittal.

C. Shop drawings shall include but not be limited to:

1. Product data sheets.

2. Drawings and written description of how the Contractor intends to furnish and install the grounding system.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. The equipment covered by these specifications shall be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be designed, constructed, and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.

2.02 GROUND RODS AND GRID

A. Ground rods shall be rolled to a commercially round shape from a welded copper-clad steel manufactured by the molten-welding process or by the electro-formed process (molecularly bonded). They shall have an ultimate tensile strength of 75,000 pounds per square inch (psi) and an elastic limit of 49,000 psi. The rods shall be not less than 3/4 inch in diameter by 10 feet in length; and the proportion of copper shall be uniform throughout the length of the rod. The copper shall have a minimum wall thickness of

0.010 inch at any point on the rod. Ground rods shall be UL 467 Listed. The ground rods shall be manufactured by Erico Products, Blackburn, or Engineer approved equal.

B. Except where specifically indicated otherwise, all exposed non-current-carrying metallic parts of electrical equipment, metallic raceway systems, grounding conductors in nonmetallic raceways, and neutral conductors of wiring systems shall be grounded.

C. The ground connection shall be made at the main service equipment and shall be extended to the ground grid surrounding the structure. The ground grid shall also be connected to the point of entrance of the metallic water service. Connection to the water pipe shall be made by a suitable ground clamp or lug connection to a plugged tee. If flanged pipes are encountered, connection shall be made with the lug bolted to the street side of the flanged connection.

D. Where ground fault protection is employed, care shall be taken so that the connection of the ground and neutral does not interfere with the correct operation of the ground fault protection system.

2.03 FITTINGS

A. Grounding connections to equipment shall be bolted. Cable end connections shall be made by hydraulic crimp or exothermically welded. All below grade terminations shall be exothermically welded. Split bolt type connectors are not acceptable. Fittings shall be UL 467 Listed.

2.04 EQUIPMENT GROUNDING CONDUCTORS

A. An insulated equipment grounding conductor, which shall be separate from the electrical system grounded (neutral) conductor, shall be furnished and installed for all circuits. Insulation shall be of the same type as the ungrounded conductors in the raceway and shall be green in color. Equipment grounding conductors shall be furnished and installed in all conduits. Use of conduits as the NEC required equipment grounding conductor is not acceptable.

2.05 EQUIPMENT GROUNDS

A. Equipment grounds shall be solid and continuous from a connection at earth to all distribution panelboards. Ground connections at panelboards, outlets, equipment, and apparatus shall be made in an approved and permanent manner.

B. For all control panels, disconnect switches, and other electrical enclosures, equipment grounds, and bonding jumpers shall be terminated individually on a ground bar or mechanical lugs. No wire nuts will be permitted.

2.06 GROUND BARS

A. Ground bars shall be furnished and installed where indicated on the Drawings and where required in the Specifications. Ground bars shall be tin-plated copper, 1/4-inch thick (minimum) with hole pairs spaced for NEMA 2-hole cable termination lugs. The number of hole pairs shall be as required for the number of cables terminated, plus four (4) spares (minimum). Ground bars shall be provided with insulated mounting hardware.

2.07 EXOTHERMIC WELDS

A. All exothermic welding shall be completed per welding kit manufacturer's instructions. Exothermic welds shall be CadWeld by Erico or ThermoWeld.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Metal surfaces where grounding connections are to be made shall be clean and dry. Steel surfaces shall be ground or filed to remove all scale, rust, grease, and dirt. Copper and galvanized steel shall be cleaned with emery cloth to remove oxide before making connections.

B. Ground Grid

1. A main ground grid shall be provided for each structure and interconnecting structure grids consisting of driven ground rods as shown on the Drawings. Ground rods shall be driven straight down into the earth, or if objects are encountered, at an angle to avoid the obstruction.

2. The ground rods shall be interconnected using copper cable sized as shown on the Drawings. The interconnecting cables shall be connected to ground rods by hydraulic crimp or exothermic weld where buried, and removable bolted clamps where shown to be installed in test wells. The grounding cables shall be installed after the excavations for the building have been completed and prior to the pouring of concrete for the footings, mats, etc. Copper "pigtails" shall be connected to the ground grid and shall enter the buildings and structure from the outside, and shall be connected to steel structures, equipment as described in this Section, and as required to provide a complete grounding system. The copper pigtails shall be hydraulically crimped or exothermically welded to the ground grid and connected to building reinforcement steel by hydraulic crimp.

3. Grounding conductors shall be continuous between points of connection; splices shall not be permitted.

4. Where conductors are exposed and subject to damage from personnel, traffic, etc., conductors shall be installed in metal raceway. The raceway shall be bonded to the grounding system.

5. Where subsurface conditions do not permit use of driven ground rods to obtain proper ground resistance, rods shall be installed in a trench or plate electrodes shall be provided, as applicable and necessary to obtain proper values of resistance.

6. Buried hydraulic crimp connections, exothermic welds, and ground ring shall not be backfilled until inspected by Engineer.

C. Raceways

1. Conduit which enters equipment such as switchgear, switchboards, motor control centers, transformers, panelboards, variable frequency drives, instrument and control panels, and similar equipment shall be bonded to the ground bus or ground lug, where provided, and as otherwise required by the NEC.

3.02 TESTING

A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 01. The following tests are required:

1. Witnessed Shop Tests

a. None required.

2. Field Tests

a. Field testing shall be done in accordance with the requirements specified in the General Conditions, Division 01, and NETA Acceptance Testing Specifications, latest edition.

b. Fall of potential tests shall be performed on the ground grid per IEEE 81 recommendations by a third party, independent testing firm. A fall of potential plot shall be submitted at the conclusion of testing for Engineer review. Documentation indicating the location of the rod and grounding system as well as the resistance and soil conditions at the time the measurements were made shall be submitted. Testing shall show that the ground grid has 5 ohms resistance or less. Due to soil conditions and/or unforeseen field conditions, ground resistances greater than 5 ohms may be acceptable if specifically approved in writing by the Engineer. Ground resistance measurements shall be made in normally dry weather not less than 48 hours after rainfall and with the ground grid under test isolated from other grounds.

c. Continuity tests for the grounding electrode conductor shall be performed. Test will be accepted when a resistance of less than 1 ohm is shown for this conductor.

END OF SECTION

SECTION 26 05 29

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish and install structural supports for mounting and installing all conduits, electrical equipment, lighting, alarm systems, instrumentation, and control and communications equipment furnished under this Contract.

B. Equipment shall be installed strictly in accordance with the manufacturer's recommendations and best practices of the trade resulting in a complete, operable, and safe installation. The Contractor shall obtain written installation manuals from the equipment manufacturer prior to installation.

C. Support design for all nonstructural electrical components (e.g., conduit and other raceways, freestanding equipment, etc.) shall be provided in accordance with the governing Building Code.

D. Reference Specification Section 26 05 00 – Basic Electrical Requirements.

1.02 CODES AND STANDARDS

A. Equipment and materials covered under this Section shall be designed, manufactured, and/or Listed to the following standards as applicable:

1. American Society for Testing and Materials (ASTM):

a. ASTM A123 – Standard Specification for Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products.

b. ASTM A153 – Standard Specification for Zinc Coating (Hot Dip) on Iron and Steel Hardware.

c. ASTM A240 – Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.

d. ASTM A276 – Standard Specification for Steel Bars and Shapes.

ASTM B783 – Standard Specification for Materials for Ferrous Powder Metallurgy Structural Parts.National Fire Protection Association (NFPA):

e. NFPA 70 – National Electrical Code (NEC).

1.03 SUBMITTALS

A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01 33 00 – Submittal Procedures, the Contractor shall obtain from the equipment manufacturer and submit the following:

1. Shop drawings

2. Structural support calculations and designs in accordance with the governing Building Code.

B. Each submittal shall be identified by the applicable Specification Section.

1.04 SHOP DRAWINGS

A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.

B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for resubmittal.

C. Shop drawings shall include but not be limited to:

1. Product data sheets.

2. Complete assembly, layout, installation, and foundation drawings with clearly marked dimensions.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. The equipment covered by this Specification is intended to be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be designed, constructed, and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.

2.02 MATERIALS

A. Support channel shall be 1-5/8” by 1-5/8” minimum, with 12-gauge material thickness.

B. Support channel, support channel fittings, and threaded rod shall be furnished with the following material of construction, dependent upon the designation of the area in which

they are to be installed. Area designations are indicated on the Drawings.

Area Designation	Material of Construction
Indoor Wet Process Area	Type 304 Stainless Steel
Indoor Dry Process Area	Hot Dipped Galvanized Steel
Indoor Dry Non-process Area	Hot Dipped Galvanized Steel
Indoor Type 1 Chemical Storage/Transfer Area	Fiberglass
Indoor Type 2 Chemical Storage/Transfer Area	Type 304 Stainless Steel
All Outdoor Areas	Type 304 Stainless Steel
All Hazardous Areas	Type 304 Stainless Steel

C. Fastening hardware (bolts, nuts, washers, and screws) shall be furnished with the following material of construction, dependent upon the designation of the area in which they are to be installed. Area designations are indicated on the Drawings.

Area Designation	Material of Construction
Indoor Wet Process Area	Type 304 Stainless Steel
Indoor Dry Process Area	Type 304 Stainless Steel
Indoor Dry Non-process Area	Type 304 Stainless Steel
Indoor Type 1 Chemical Storage/Transfer Area	Fiberglass
Indoor Type 2 Chemical Storage/Transfer Area	Type 304 Stainless Steel
All Outdoor Areas	Type 304 Stainless Steel
All Hazardous Areas	Type 304 Stainless Steel

PART 3 – EXECUTION

3.01 INSTALLATION

A. Concrete or Masonry Inserts

1. The Contractor shall be responsible for the furnishing and installation of all anchor bolts, masonry inserts, and similar devices required for installation of equipment furnished under this Contract.

2. If a time delay for the arrival of any special inserts or equipment drawings, etc. occurs, the Contractor may, if permitted by the Engineer, make arrangements for providing approved recesses and openings in the concrete or masonry and, upon subsequent installation, the Contractor shall be responsible for filling in such recesses and openings. Any additional costs that may be incurred by this procedure shall be borne by the Contractor.

3. The Contractor shall furnish leveling channels for all switchgear, switchboards, motor control centers, and similar floor mounted equipment. The leveling channels shall be provided for embedment in the equipment housekeeping pads. Coordination of the installation of these channels with the concrete pad is essential and required. Pad height shall be as required to maintain concrete coverage of the reinforcement bars while not causing associated equipment to exceed the maximum mounting height requirements of the NEC.

B. Support Fastening and Locations

1. All equipment fastenings to columns, steel beams, and trusses shall be by beam clamps or welded. No holes shall be drilled in the steel.

2. Unless otherwise indicated on the Drawings or in the Specifications, guards/handrails shall not be utilized as supports for electrical equipment, devices, or appurtenances. Guards/handrails shall not be cut, drilled, or otherwise modified in order to accommodate electrical supports without written approval from the Engineer.

3. All holes made in reflected ceilings for support rods, conduits, and other equipment shall be made adjacent to ceiling grid bars, where possible, to facilitate removal of ceiling panels.

4. Support channel shall be provided wherever required for the support of starters, switches, panels, and miscellaneous equipment.

5. Equipment, devices, and raceways that are installed on the dry side of a water bearing wall shall not be installed directly onto the wall. Support channel shall be used to allow ventilation air to pass behind the equipment, devices, or raceway.

6. All supports shall be rigidly bolted together and braced to make a substantial supporting framework. Where possible, control equipment shall be grouped together and mounted on a single framework.

7. Aluminum support members shall not be installed in direct contact with concrete. Stainless steel or non-metallic "spacers" shall be used to prevent contact of aluminum with concrete.

8. Actual designs for supporting framework should take the nature of a picture frame of support channels and bracket with a plate for mounting the components. The Contractor is responsible for the design of supporting structure; Contractor shall submit design details to the Engineer for acceptance before proceeding with the fabrication.

9. Wherever dissimilar metals come into contact, the Contractor shall isolate these metals as required with neoprene washers, nine (9) mil polyethylene tape, or gaskets.

10. For all installations where fiberglass supporting materials are required, the Contractor shall submit structural calculations and the details of the proposed system of support. Structural calculations shall be signed and sealed by a Professional Engineer (P.E.) licensed in the State or Commonwealth in which the project is located.

11. For the following installations where conduits are provided with a support system suspended from the above or attached to a vertical structure, the Contractor shall submit structural calculations and details of the proposed system of support. Structural calculations shall be signed and sealed by a Professional Engineer (P.E.) licensed in the State or Commonwealth in which the project is located.

    a. A quantity of twelve (12) or more conduits trade size 1” and smaller are proposed for a conduit support rack.

    b. A quantity of eight (8) or more conduits trade sizes 1 ½” to 2 1/2” are proposed for a conduit support rack.

    c. A quantity of four (4) or more conduits trade sizes 3” and larger are proposed for a conduit support rack.

12. Single conduits installed exposed along walls and ceilings shall be secured to the wall or ceiling with a one-hole conduit clamp and clamp-back. Where multiple conduits are installed exposed together, support channel and conduit clamps shall be used.

C. Equipment, boxes, and enclosures which are factory-constructed with integral mounting provisions (such as brackets, mounting feet, bolt holes, etc.) shall be installed/supported utilizing those mounting provisions. Equipment, boxes and enclosures shall not be field-modified by any means which compromises the UL Listing or NEMA rating of the enclosure/assembly.

END OF SECTION

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SECTION 26 05 33.13
CONDUIT FOR ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish and install conduits, conduit fittings, and appurtenances to complete the installation of all electrically operated equipment as specified herein, indicated on the Drawings, and as required.

B. Reference Specification Section 26 05 00 – Basic Electrical Requirements.

C. Requirements for conduit clamps, support systems, and anchoring are not included in this Section. Reference Specification Section 26 05 29 – Hangers and Supports for Electrical Systems, for these requirements.

1.02 CODES AND STANDARDS

A. All equipment and materials shall be Listed by and shall bear the Label of Underwriter's Laboratories, Incorporated (UL).

B. Conduits, conduit fittings, and appurtenances shall be designed, manufactured, and/or Listed to the following standards as applicable:

1. American National Standards Institute (ANSI)

    a. ANSI/ASME B1.20.1 – Pipe Threads, General Purpose.

    b. ANSI C80.1 – Electrical Rigid Steel Conduit.

    c. ANSI C80.5 – Electrical Rigid Aluminum Conduit.

    d. ANSI/NEMA FB 1 – Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable.

2. National Electrical Contractors Association (NECA):

    a. NECA 1 – Standard for Good Workmanship in Electrical Construction.

3. National Electrical Manufacturer’s Association (NEMA):

    a. NEMA FB 2.40 – Installation Guidelines for Expansion and Expansion/Deflection Fittings.

b. NEMA RN 1 – PVC Externally Coated Galvanized Rigid Steel Conduit.

c. NEMA RV-3 – Application and Installation Guidelines for Flexible and Liquid-tight Flexible Metal and Nonmetallic Conduits.

d. NEMA TC-2 – Electrical PVC Conduit.

e. NEMA TC-3 – PVC Fittings for Use with Rigid PVC Conduit and Tubing.

4. National Fire Protection Association (NFPA):

a. NFPA 70 – National Electrical Code (NEC).

5. Underwriters Laboratories (UL):

a. UL 1 – Standard for Flexible Metal Conduit.

b. UL 6 – Electrical Rigid Metal Conduit-Steel.

c. UL 6A – Electrical Rigid Metal Conduit-Aluminum, Red Brass, and Stainless Steel.

d. UL 360 – Standard for Liquid-tight Flexible Metal Conduit.

e. UL 467 – Grounding and Bonding Equipment.

f. UL 514B – Conduit, Tubing, and Cable Fittings.

g. UL 651 – Standard for Schedule 40 and 80 Conduit and Fittings.

h. UL 1203 – Standard for Explosion-proof and Dust-ignition-proof Electrical Equipment for use in Hazardous (Classified) Locations.

i. UL 1479 – Standard for Fire Tests of Penetration Fire Stops.

j. UL 1660 – Liquid-tight Flexible Nonmetallic Conduit.

6. Others:

a. American Concrete Institute (ACI): ACI 318 – Building Code Requirements for Structural Concrete.

b. Aluminum Association – Aluminum and It’s Alloys.

1.03 SUBMITTALS

A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01 33 00 – Submittal Procedures, the Contractor shall obtain from the equipment manufacturer and submit the following:

1. Shop Drawings

B. Each submittal shall be identified by the applicable Specification Section.

1.04 SHOP DRAWINGS

A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.

B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for resubmittal.

C. Shop drawings shall include but not be limited to:

1. Conduit identification methods and materials.

2. Product data sheets for conduits, fittings, and miscellaneous associated materials.

a. The product data sheets for conduits and fittings for up to three (3) manufacturers for each type of conduit specified herein will be reviewed if they are submitted at the same time under the same submittal cover for simultaneous review.

b. Despite the number of manufacturers that may be approved, only one manufacturer of PVC coated rigid metal conduit will be permitted to be installed on this project in accordance with the requirements set forth in Part 3 herein.

3. Manufacturer’s Warranty Statement for PVC coated rigid metal conduit.

4. Evidence of training for all personnel that will install PVC coated rigid metal conduit.

1.05 DEFINITIONS

A. Conduits are categorized by the circuit type of the wiring to be installed inside. Conduits are defined as follows:

1. Power Conduits – Conduits that carry AC or DC power wiring from a source to a load. Conduits that carry lighting and receptacle wiring.

2. Control Conduits – Conduits that carry AC or DC discrete control wiring between devices and/or equipment. Also, conduits that carry fiber optic cables between devices and/or equipment.

3. Instrumentation Conduits – Conduits that carry AC or DC analog signal wiring between devices and/or equipment. Conduits that carry Category 5e or Category 6 unshielded twisted-pair cables.

PART 2 – PRODUCTS

2.01 GENERAL

A. Conduit and conduit fitting products are specified in the text that follows this article. Reference Part 3 herein for the application, uses, and installation requirements of these conduits and conduit fittings.

B. All metallic conduit fittings shall be UL 514B and UL 467 Listed and constructed in accordance with ANSI FB 1. All metallic conduit fittings for use in Class I, Division 1 hazardous areas shall be UL 1203 Listed with a visible certification tag on the outside of the fitting. All non-metallic fittings shall be UL 651 Listed and constructed in accordance with NEMA TC-3.

C. Flexible conduit couplings for use in Class I, Division 1 hazardous areas shall have threaded Type 316 stainless steel end fittings and a flexible braided core. Flexible braid shall be constructed of Type 316 stainless steel where available in the conduit trade size required for the application. Where Type 316 stainless steel braid is not available, the braid shall be provided with a factory-applied PVC coating. No other braid types or materials are acceptable.

D. Where threading is specified herein for conduit fitting connections, the fittings shall be manufactured to accept conduit that is threaded to ANSI B1.20.1 requirements.

E. Conduit expansion fittings for all conduit materials of construction shall be capable of 4 inches of movement along the axis of the conduit for trade sizes 2 inches or less. Expansion fittings shall be capable of 8 inches of movement along the axis of the conduit for trade sizes greater than 2 inches.

F. Conduit deflection fittings for all conduit materials of construction shall be provided with a flexible neoprene outer jacket that permits up to ¾ inch of expansion/contraction along the axis of the conduit as well as up to ¾ inch of parallel misalignment between the conduit axes. Outer jacket shall be secured to the conduit hubs by Type 304 stainless steel clamps.

G. Conduit seals shall either be Listed and Labeled for 40% fill, or conduit reducing fittings and a trade size larger conduit seal shall be provided to achieve 25% or less fill within the seal. Percentage fill calculation shall be based on the conductors to be installed. Conduit seals shall be provided with breathers and/or drains where required by the NEC.

H. Conduit insulating bushings shall be constructed of plastic and shall have internal threading.

I. Additional conduit and conduit fitting requirements are specified in the articles that follow based on the specific conduit material of construction to be used.

2.02 RIGID GALVANIZED STEEL (RGS) CONDUIT AND ASSOCIATED FITTINGS

A. Conduit

1. Conduit shall be hot dip galvanized on the inside and outside and made of heavy wall high strength ductile steel. Conduit shall be manufactured in accordance with ANSI C80.1 and shall be UL 6 Listed.

2. Conduit shall be provided with factory-cut 3/4 inch per foot tapered threads at each end in accordance with ANSI B1.20.1. Threads shall be cut prior to galvanizing to ensure corrosion protection adequately protects the threads. Conduit shall be provided with a matching coupling on one end and a color-coded thread protector on the other.

B. Conduit Bodies for use with Rigid Galvanized Steel

1. Conduit bodies shall be constructed of an electro-galvanized malleable iron alloy which is coated with an acrylic paint finish. Conduit bodies shall have integral threaded conduit hubs.

2. Conduit bodies for Class I, Division 1 hazardous areas shall be provided with integrally threaded covers constructed of an electro-galvanized malleable iron alloy which is coated with an acrylic paint finish.

3. Conduit bodies for all other areas shall be provided with covers that are affixed in place by Type 304 stainless steel screws which thread directly into the conduit body. Covers that utilize wedge nuts or any other method of attachment to the conduit body are not acceptable. Covers shall be constructed of an electro-galvanized malleable iron alloy which is coated with an acrylic paint finish. Covers shall be provided with matching gasket.

C. Conduit Couplings, Nipples, and Unions for use with Rigid Galvanized Steel

1. Couplings and nipples shall be threaded and shall be constructed of hot dipped galvanized steel. Split-type couplings that use compression to connect conduits are not acceptable.

2. Unions shall be threaded, rain-tight, and constructed of an electro-galvanized malleable iron alloy which is coated with an acrylic paint finish.

D. Conduit Expansion and Deflection Fittings for use with Rigid Galvanized Steel

1. Conduit expansion fittings and conduit deflection fittings shall be constructed of bronze or an electro-galvanized malleable iron alloy. Expansion and deflection fittings shall have threaded conduit connections.

2. Expansion fittings shall have an integral bonding jumper and deflection fittings shall have an external bonding jumper.

E. Conduit Seals for use with Rigid Galvanized Steel

1. Conduit seals shall be constructed of an electro-galvanized malleable iron alloy which is coated with an acrylic paint finish. Conduit seals shall have threaded conduit connections.

F. Conduit Termination Fittings for use with Rigid Galvanized Steel

1. Conduit hubs shall be constructed of Type 316 stainless steel and shall have threaded connections to the conduit and enclosure. Hubs shall have a plastic insulated throat and shall be watertight when assembled to an enclosure.

2. Conduit locknuts shall be constructed of zinc plated steel. Locknuts shall have internal threading. Locknuts with integral gasket or seal are not acceptable as the sole means of sealing. Locknuts shall have integral bonding screw where required for proper bonding.

3. Conduit bonding bushings shall be constructed of zinc plated malleable iron. Bonding bushings shall have a threaded conduit connection. Bonding bushing shall be provided with properly sized set screw for connecting bonding conductor and an integral plastic insulator rated for 150 degrees C located in the throat.

2.03 RIGID NONMETALLIC CONDUIT AND ASSOCIATED FITTINGS

A. Conduit

1. Conduit shall be Schedule 40 or 80 (dependent on application) polyvinyl chloride (PVC) construction, manufactured in accordance with NEMA TC-2, UL 651 Listed, and suitable for conductors with 90 degree C insulation.

B. Conduit Bodies for use with Rigid Nonmetallic Conduit

1. Conduit bodies shall be constructed of PVC. Conduit hubs shall be integral to the conduit body and shall be smooth inside to accept a glued conduit connection.

2. Conduit body shall be provided with cover that is affixed in place by Type 304 stainless steel screws which thread directly into the conduit body. Covers that utilize wedge nuts or any other method of attachment to the conduit body are not acceptable. Covers shall be provided with matching gasket.

C. Conduit Couplings and Unions for use with Rigid Nonmetallic Conduit

1. Conduit couplings and unions shall be constructed of PVC and shall be smooth inside to accept a glued conduit connection.

D. Conduit Expansion and Deflection Fittings for use with Rigid Nonmetallic Conduit

1. Conduit expansion fittings and conduit deflection fittings shall be constructed of PVC and shall be smooth inside to accept a glued conduit connection.

E. Conduit Termination Fittings for use with Rigid Nonmetallic Conduit

1. Conduit hubs shall be constructed of PVC and shall be smooth inside to accept a glued conduit connection. Hubs shall have external threads and an accompanying PVC locknut and shall be watertight when assembled to an enclosure.

2. Conduit locknuts shall be constructed of zinc plated steel. Locknuts shall have internal threading. Locknuts constructed of PVC and locknuts with integral gasket or seal are not acceptable.

3. Conduit end bells shall be constructed of PVC and shall be smooth inside to accept a glued conduit connection. End bell shall have a smooth inner surface that curves outward towards the edge of the fitting.

2.04 PVC COATED RIGID GALVANIZED STEEL CONDUIT AND ASSOCIATED FITTINGS

A. General

1. Where an external coating of polyvinyl chloride (PVC) is specified for conduit and fittings, the coating shall be 40 mil (minimum) thickness. Where an internal coating of urethane is specified for conduit and fittings, the coating shall be 2 mil (minimum) thickness.

2. All conduit fittings shall have a sealing sleeve constructed of PVC which covers all connections to conduit. Sleeves shall be appropriately sized so that no conduit threads will be exposed after assembly.

3. PVC coated conduit and associated PVC coated fittings shall be Ocal-Blue by ABB, Plasti-Bond by Robroy Industries, or Perma-Cote by Robroy Industries, no substitutions.

4. PVC coated conduit and associated PVC coated fittings shall be provided with a 5-year non-prorated warranty covering manufacturing defects and improper installation by the Contractor.

B. Conduit

1. Conduit shall be hot dip galvanized on the inside and outside and made of heavy wall high strength ductile steel. Conduit shall be manufactured in accordance with ANSI C80.1 and shall be UL 6 Listed.

2. Conduit shall be provided with factory-cut 3/4 inch per foot tapered threads at each end in accordance with ANSI B1.20.1. Threads shall be cut prior to galvanizing to ensure corrosion protection adequately protects the threads. Conduit shall be provided with a matching coupling on one end and a color-coded thread protector on the other.

3. Conduit shall be coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane. Conduit shall be manufactured in accordance with NEMA RN 1.

C. Conduit Bodies for use with PVC Coated Rigid Galvanized Steel Conduit

1. Conduit bodies shall be constructed of an electro-galvanized malleable iron alloy which is coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane. Conduit bodies shall have integral threaded conduit hubs.

2. Conduit bodies for Class I, Division 1 hazardous areas shall be provided with integrally threaded covers constructed of an electro-galvanized malleable iron alloy which is coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane.

3. Conduit bodies for all other areas shall be constructed of an electro-galvanized malleable iron alloy which is coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane. Covers shall be affixed in place by Type 304 stainless steel screws which thread directly into the conduit body and have a plastic encapsulated head. Covers that utilize wedge nuts or any other method of attachment to the conduit body are not acceptable. Covers shall be provided with matching gasket.

D. Conduit Couplings, Nipples, and Unions for use with PVC Coated Rigid Galvanized Steel Conduit

1. Couplings and nipples shall be threaded and shall be constructed of hot dipped galvanized steel which is coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane. Split-type couplings that use compression to connect conduits are not acceptable.

2. Unions shall be threaded, rain-tight, and constructed of an electro-galvanized malleable iron alloy which is coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane.

E. Conduit Expansion and Deflection Fittings for use with PVC Coated Rigid Galvanized Steel Conduit

1. Conduit expansion fittings and conduit deflection fittings shall be constructed of bronze or an electro-galvanized malleable iron alloy which is coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane. Expansion and deflection fittings shall have threaded conduit connections.

2. Expansion fittings shall have an integral bonding jumper and deflection fittings shall have an external bonding jumper.

F. Conduit Seals for use with PVC Coated Rigid Galvanized Steel Conduit

1. Conduit seals shall be constructed of an electro-galvanized malleable iron alloy which is coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane. Conduit seals shall have threaded conduit connections.

G. Conduit Termination Fittings for Use with PVC Coated Rigid Galvanized Steel Conduit

1. Conduit hubs shall be constructed of an electro-galvanized malleable iron alloy which is coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane. Hubs shall have threaded connections to the conduit and enclosure. Hubs shall have a plastic insulated throat and shall be watertight when assembled to an enclosure.

2. Conduit bonding bushings shall be constructed of zinc plated malleable iron which is coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane. Bonding bushings shall have a threaded conduit connection. Bonding bushing shall be provided with properly sized set screw for connecting bonding conductor and an integral plastic insulator rated for 150 degrees C located in the throat.

2.05 RIGID ALUMINUM CONDUIT AND ASSOCIATED FITTINGS

A. Conduit

1. Conduit shall be made of heavy wall high strength 6063 alloy aluminum with temper designation T1 as defined by the Aluminum Association. Conduit shall be manufactured in accordance with ANSI C80.5 and shall be UL 6A Listed.

2. Conduit shall be provided with factory-cut 3/4 inch per foot tapered threads at each end in accordance with ANSI B1.20.1. Threads shall be cut prior to galvanizing to ensure corrosion protection adequately protects the threads. Conduit shall be provided with a matching coupling on one end and a color-coded thread protector on the other.

B. Conduit Bodies for use with Rigid Aluminum Conduit

1. Conduit bodies shall be constructed of copper-free aluminum which is coated with an aluminum enamel finish. Conduit bodies shall have integral threaded conduit hubs.

2. Conduit bodies for Class I, Division 1 hazardous areas shall be provided with integrally threaded covers constructed of copper-free aluminum which is coated with an aluminum enamel finish.

3. Conduit bodies for all other areas shall be provided with stamped copper-free aluminum covers that are affixed in place by Type 304 stainless steel screws which thread directly into the conduit body. Covers that utilize wedge nuts or any other method of attachment to the conduit body are not acceptable. Covers shall be provided with matching gasket.

C. Conduit Couplings, Nipples, and Unions for use with Rigid Aluminum Conduit

1. Couplings and nipples shall be threaded and shall be constructed of heavy wall high strength 6063 alloy aluminum with temper designation T1. Split-type couplings that use compression to connect conduits are not acceptable.

2. Unions shall be threaded, rain-tight, and constructed of copper-free aluminum which is coated with an aluminum enamel finish.

D. Conduit Expansion and Deflection Fittings for use with Rigid Aluminum Conduit

1. Conduit expansion fittings and conduit deflection fittings shall be constructed of copper-free aluminum which is coated with an aluminum enamel finish. Expansion and deflection fittings shall have threaded conduit connections.

2. Expansion fittings shall have an integral bonding jumper and deflection fittings shall have an external bonding jumper.

E. Conduit Seals for use with Rigid Aluminum Conduit

1. Conduit seals shall be constructed of copper-free aluminum which is coated with an aluminum enamel finish. Conduit seals shall have threaded conduit connections.

F. Conduit Termination Fittings for use with Rigid Aluminum Conduit

1. Conduit hubs shall be constructed of copper-free aluminum and shall have threaded connections to the conduit and enclosure. Hubs shall have a plastic insulated throat and shall be watertight when assembled to an enclosure.

2. Conduit locknuts shall be constructed of copper-free aluminum. Locknuts shall have internal threading. Locknuts with integral gasket or seal are not acceptable. Locknuts shall have integral bonding screw where required for proper bonding.

3. Conduit bonding bushings shall be constructed of copper-free aluminum. Bonding bushings shall have a threaded conduit connection. Bonding bushing shall be provided with properly sized set screw for connecting bonding conductor and an integral plastic insulator rated for 150 degrees C located in the throat.

2.06 PVC COATED RIGID ALUMINUM CONDUIT AND ASSOCIATED FITTINGS

A. General

1. Where an external coating of polyvinyl chloride (PVC) is specified for conduit and fittings, the coating shall be 40 mil (minimum) thickness. Where an internal coating of urethane is specified for conduit and fittings, the coating shall be 2 mil (minimum) thickness.

2. All conduit fittings shall have a sealing sleeve constructed of PVC which covers all connections to conduit. Sleeves shall be appropriately sized so that no conduit threads will be exposed after assembly.

3. PVC coated conduit and associated PVC coated fittings shall be Ocal-Blue by ABB, Plasti-Bond by Robroy Industries, or Perma-Cote by Robroy Industries, no substitutions.

4. PVC coated conduit and associated PVC coated fittings shall be provided with a 5-year non-prorated warranty covering manufacturing defects and improper installation by the Contractor.

B. Conduit

1. Conduit shall be made of heavy wall high strength 6063 alloy aluminum with temper designation T1. Conduit shall be manufactured in accordance with ANSI C80.5 and shall be UL 6A Listed.

2. Conduit shall be provided with factory-cut 3/4 inch per foot tapered threads at each end in accordance with ANSI B1.20.1. Threads shall be cut prior to galvanizing to ensure corrosion protection adequately protects the threads. Conduit shall be provided with a matching coupling on one end and a color-coded thread protector on the other.

3. Conduit shall be coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane. Conduit shall be manufactured in accordance with NEMA RN 1.

C. Conduit Bodies for use with PVC Coated Rigid Aluminum Conduit

1. Conduit bodies shall be constructed of copper-free aluminum which is coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane. Conduit bodies shall have integral threaded conduit hubs.

2. Conduit bodies for Class I Division 1 hazardous areas shall be provided with integrally threaded covers constructed of copper-free aluminum which is coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane.

3. Conduit bodies for all other areas shall be constructed of copper-free aluminum which is coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane. Covers shall be affixed in place by Type 304 stainless steel screws which thread directly into the conduit body and have a plastic encapsulated head. Covers that utilize wedge nuts or any other method of attachment to the conduit body are not acceptable. Covers shall be provided with matching gasket.

D. Conduit Couplings, Nipples, and Unions for use with PVC Coated Rigid Aluminum Conduit

1. Couplings and nipples shall be threaded and shall be constructed of copper-free aluminum which is coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane. Split-type couplings that use compression to connect conduits are not acceptable.

2. Unions shall be threaded, rain-tight, and constructed of copper free aluminum which is coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane.

E. Conduit Expansion and Deflection Fittings for use with PVC Coated Rigid Aluminum Conduit

1. Conduit expansion fittings and conduit deflection fittings shall be constructed of copper-free aluminum which is coated on the exterior with a PVC jacket and

coated on the interior with a layer of urethane. Expansion and deflection fittings shall have threaded conduit connections.

2. Expansion fittings shall have an integral bonding jumper and deflection fittings shall have an external bonding jumper.

F. Conduit Seals for use with PVC Coated Rigid Aluminum Conduit

1. Conduit seal shall be constructed of copper-free aluminum which is coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane. Conduit seals shall have threaded conduit connections.

G. Conduit Termination Fittings for use with PVC Coated Rigid Aluminum Conduit

1. Conduit hubs shall be constructed of copper-free aluminum which is coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane. Hubs shall have threaded connections to the conduit and enclosure. Hubs shall have a plastic insulated throat and shall be watertight when assembled to an enclosure.

2. Conduit bonding bushings shall be constructed of copper-free aluminum which is coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane. Bonding bushings shall have a threaded conduit connection. Bonding bushing shall be provided with properly sized set screw for connecting bonding conductor and an integral plastic insulator rated for 150 degrees C located in the throat.

2.07 LIQUID TIGHT FLEXIBLE METAL CONDUIT (LFMC) AND ASSOCIATED FITTINGS

A. Conduit

1. Conduit shall be manufactured using a single strip of hot dip galvanized high strength steel alloy, helically formed into a continuously interlocked flexible metal conduit. Trade size 1-1/4 inch and smaller conduits shall be provided with an integrally woven copper bonding strip.

2. Conduit shall be covered with an outside PVC jacket that is UV resistant, moisture-proof, and oil-proof. Conduit shall be UL 360 Listed. Conduits shall be Listed for and marked with maximum temperature ratings as follows:

a. 105 degrees C dry, 60 degrees C wet for all conduit installed against or within 2 inches of equipment capable of having a surface temperature of 80 degrees C or greater (e.g., blowers, incinerators, etc.)

b. 80 degrees C dry, 60 degrees C wet for all other locations

B. Conduit Termination Fittings for use with LFMC

1. Conduit termination fittings shall be constructed of either Type 304 stainless steel or an electro-galvanized malleable iron alloy which is coated on the exterior with a 40 mil (minimum) PVC jacket and coated on the interior with a 2 mil (minimum) layer of urethane. PVC coated fittings shall have a sealing sleeve constructed of PVC which covers the connection to conduit.

2. Termination fittings shall have a threaded end with matching locknut and sealing ring for termination to equipment and shall have an integral external bonding lug where required for proper bonding. Termination fittings shall have a plastic insulated throat and shall be watertight when assembled to the conduit and equipment.

LIQUID TIGHT FLEXIBLE NONMETALLIC CONDUIT (LFNC) AND ASSOCIATED FITTINGS

C. Conduit

1. Conduit shall be constructed of rigid polyvinyl chloride (PVC), fabricated to provide flexibility. Conduit shall be covered with an outside PVC jacket that is UV resistant, moisture-proof, and oil-proof. Conduit shall be UL 1660 Listed and be Type LFNC-B.

D. Conduit Termination Fittings for use with LFNC

1. Conduit termination fittings shall be constructed PVC and shall have a threaded end with matching locknut and sealing ring for termination to equipment. Termination fittings shall be watertight when assembled to the conduit and equipment.

2.08 FLEXIBLE METAL CONDUIT (FMC) AND ASSOCIATED FITTINGS

A. Conduit

1. Conduit shall be manufactured using a single strip of hot dip galvanized high strength steel alloy, helically formed into a continuously interlocked flexible metal conduit. Conduit shall be UL 1 Listed.

B. Conduit Termination Fittings for use with FMC

1. Conduit termination fittings shall be constructed of an electro-galvanized malleable iron alloy. Fittings shall have a threaded end with matching locknut for termination to equipment, and a compression-style connection to the associated conduit.

2.09 ELECTRICAL METALLIC TUBING (EMT) AND ASSOCIATED FITTINGS (NONE THIS PROJECT)

A. Conduit

1. Conduit shall be hot dipped galvanized on the inside and outside and made of cold-rolled steel tubing. Conduit shall be manufactured in accordance with C80.3 and shall be UL 797 Listed.

B. Conduit Bodies for use with EMT

1. Conduit bodies shall be constructed of an electro-galvanized malleable iron alloy which is coated with an acrylic paint finish. Conduit bodies shall have integral threaded conduit hubs.

2. Conduit bodies shall be provided with galvanized sheet steel covers that are affixed in place by Type 304 stainless steel screws which thread directly into the conduit body. Covers that utilize wedge nuts or any other method of attachment to the conduit body are not acceptable. Covers shall be provided with matching gasket.

C. Conduit Couplings and Nipples for use with EMT

1. Couplings and nipples shall have threaded compression connectors with associated gland and shall be constructed of electro-galvanized steel. Fittings utilizing a set screw or indenter tool to secure the associated conduit to the fitting are not acceptable. Couplings and nipples shall be rain-tight and have a plastic insulated throat.

D. Conduit Expansion and Deflection Fittings for use with EMT

1. Conduit expansion fittings and conduit deflection fittings shall be constructed of an electro-galvanized malleable iron alloy which is coated with an acrylic paint finish. Expansion and deflection fittings shall have threaded conduit connections.

2. Expansion fittings shall have an integral bonding jumper and deflection fittings shall have an external bonding jumper.

E. Conduit Termination Fittings for use with EMT

1. Conduit termination fittings shall be constructed of electro-galvanized steel and have a plastic insulated throat. Termination fittings shall have a threaded compression connector with associated gland on one end and external threads on the other end. Termination fittings utilizing a set screw or indenter tool to secure the associated conduit to the fitting are not acceptable.

2. Conduit locknuts shall be constructed of zinc plated steel. Locknuts shall have internal threading. Locknuts shall have integral bonding screw where required for proper bonding.

2.10 CONDUIT BENDS

A. Rigid conduit bends, both factory-fabricated and field-fabricated, shall meet the same requirements listed in the articles above for the respective conduit type and material of construction.

B. Conduit bend radii for standard radius bends shall be no less than as follows:

Trade Size (inches)	3/4	1	1-1/4	1-1/2	2	2-1/2	3	3-1/2	4	5	6
Min. Radius (inches)	4-1/2	5-3/4	7-1/4	8-1/4	9-1/2	10-1/2	13	15	16	24	30

C. Conduit bend radii for long radius bends shall be no less than as follows:

Trade Size (inches)	3/4	1	1-1/4	1-1/2	2	2-1/2	3	3-1/2	4	5	6
Min. Radius (inches)	N/A	12	18	24	30	30	36	36	48	48	60

2.11 MISCELLANEOUS

A. Conduit Periphery Sealing

1. The sealing of the exterior surface of conduits to prevent water and/or air from passing around the conduit periphery from one space to another (where required) shall be by one of the following:

   a. A conduit sleeve and pressure bushing sealing system. Acceptable products are FSK by OZ-GEDNEY, Link-Seal by Crouse-Hinds, or Engineer approved equal.

   b. A conduit sleeve that is two trade sizes larger than the conduit being sealed, with 2-hour fire rated UL 1479 Listed caulk filling the entire void between the conduit and sleeve. This method is only suitable for penetrations in non-fire rated walls and floors.

   c. Conduit penetrations through fire-rated walls and floors shall be made with an approved UL 1479 Listed product specifically intended for the trade size of the conduit.

2. See Part 3 herein for the specific application of the conduit periphery sealing requirements above that are to be used based on what the conduit will be penetrating.

B. Primer and Cement

1. Nonmetallic conduit shall be cleaned with primer and connected to fittings with the manufacturer's recommended cement that is labeled Low VOC.

C. Galvanizing Compounds

1. Galvanizing compounds for field application shall be the cold-applied type, containing no less than 93% pure zinc.

D. Conduit Interior Sealing

1. For all conduits that have cables inside, the sealing of the inside of the conduits against water ingress shall be achieved by one of the following:

   a. Two-part expanding polyurethane foam sealing compound, dispensed from a single tube which mixes the two parts as it is injected into the conduit. Expanding foam shall be compatible with the conduit material of construction as well as the outer jacket of the cables in the conduit. Acceptable products are Q-Pak 2000 by Chemque, FST by American Polywater Corporation, or Hydra-seal S-60 by Duraline.

   b. Inflatable bag that provides seal around cables and around inside diameter of conduit. Provide appropriate quantity of additional fittings for applications with three or more cables in the conduit to be sealed. Acceptable products are Rayflate by Raychem, or Engineer approved equal. This sealing method is only applicable to conduits trade size 2 inch and larger.

   c. Neoprene sealing ring provided with the required quantity and diameter of holes to accommodate the cables in each conduit. Sealing ring shall be compressed by two Type 304 stainless steel pressure plates. Acceptable products are type CSB by OZ-GEDNEY, or Engineer approved equal. This sealing method is only applicable to metallic conduits containing 4 or less cables.

2. The use of aerosol-based expanding foam sealants or any other method of sealing against water ingress not listed above is not acceptable.

3. For conduits identified as spares, the sealing of the inside of the conduit against water ingress shall be achieved by using appropriately sized rubber expanding-style conduit plugs.

E. Pull Rope

1. Pull ropes for empty and/or spare conduits shall be woven polyester, ½-inch wide, with a minimum tensile strength of 1250 lbs. In addition, pull ropes for conduits that

are installed concealed shall also have a 22-AWG (minimum) tin-plated copper conductor woven in to make the rope detectable.

2. Pull ropes for the Contractors use in installing conductors shall be the size and strength required for the pull and shall be made of a non-metallic material.

PART 3 – EXECUTION

3.01 GENERAL

A. All conduit and associated fittings and appurtenances shall be installed in accordance with NECA 1.

B. Minimum trade size for all rigid conduits shall be 1 inch if any portion of the conduit is installed in a ductbank or direct buried and 3/4 inch for all other applications. Conduits installed within duct banks shall be allowed to be increased in size to trade size 2 inch, at the Contractor's option, to accommodate the saddle size of the ductbank spacers. However, no combining of circuits shall be allowed in the larger conduits.

C. Minimum trade size for flexible conduits (where specifically allowed herein) shall be 1/2 inch in all applications.

D. Conduit routing and/or homeruns within structures is not shown on the Drawings. Conduits shall be installed concealed wherever practical and within the limitations specified herein. All other conduits not capable of being installed concealed shall be installed exposed.

E. Empty and/or spare conduits shall be provided with pull lines which have no less than 12 inches of slack at each end.

F. Nonmetallic conduits for installations requiring less than a factory length of conduit shall be field cut to the required length. The cut shall be made square, cleaned of debris, and primer shall be applied to ready each joint for fusing. Conduits shall then be fused together with the conduit manufacturer's approved cement compound.

G. Metallic conduits for installations requiring less than a factory length of conduit shall be field cut to the required length. The cut shall be made square, be cleaned of all debris and be de-burred, then threaded. Conduit threading performed in the field shall be ¾ inch per foot tapered threads in accordance with ANSI B1.20.1.

H. Conduits shall be protected from moisture, corrosion, and physical damage during construction. Install dust-tight and water-tight conduit fittings on the ends of all conduits immediately after installation and do not remove until conductors are installed.

I. Conduits shall be installed to provide no less than 12 inches clearance from pipes that have the potential to impart heat upon the conduit. Such pipes include, but are not limited to, hot water pipes, steam pipes, exhaust pipes, and blower air pipes. Clearance shall be maintained whether conduit is installed in parallel or in crossing of pipes.

J. Where non-metallic or aluminum instrumentation conduits are installed exposed, the following clearances to other conduit types shall be maintained:

Installation Scenario	Clearance
Parallel to conduits with conductors energized at 480V or above	18 inches
Parallel to conduits with conductors energized at 240V and below	12 inches
At right angles to conductors energized at 480V and below	6 inches
At right angles to conductors energized at voltages above 480V	12 inches

K. Where conduit fittings do not include an integral insulated bushing, an insulated bushing shall be installed at all conduit termination points.

L. Conduits which serve multi-section equipment shall be terminated in the section where wiring terminations will be made.

M. Conduits shall not penetrate the floors or walls inside liquid spill containment areas without specific written authorization from the Engineer. Liquid spill containment areas are indicated on the Drawings.

N. Conduits shall only penetrate the walls of liquid-holding tanks or basins above the maximum liquid elevation. Conduits shall not penetrate walls below this elevation. Maximum liquid elevations are indicated on the Drawings.

O. Conduits that terminate at roof mounted equipment shall be installed through the roof curb for the associated equipment to avoid additional roof penetrations wherever possible. Conduits that are installed horizontally on roof surfaces shall be supported by roof blocks that do not impact the roof manufacturer's warranty and shall be installed at least 7/8 inch above the roof surface to avoid the need to further de-rate the conductors inside.

P. In no case shall conduit be supported or fastened to another pipe or be installed in a manner that would prevent the removal of other pipes for repairs. Spring steel fasteners may only be used to affix conduits containing lighting branch circuits within EMT conduits to structural steel members.

Q. All field fabricated threads for rigid galvanized steel conduit shall be thoroughly coated with two coats of galvanizing compound, allowing at least two minutes to elapse between coats for proper drying.

R. The appropriate specialized tools shall be used for the installation of PVC coated conduit and conduit fittings. No damage to the PVC coating shall occur during installation. Conduit and conduit fittings with damaged PVC coating shall be replaced at the Contractor's cost. The use of PVC coating touch-up compounds is not permitted.

S. If multiple manufacturers of PVC coated conduit and conduit fittings are reviewed and approved for use by the Engineer, only one manufacturer shall be permitted to be used on the project throughout the entirety of the project. Consistency of a single manufacturer is critical to ensure proper fit and alignment, and to maintain the manufacturer's warranty throughout the PVC coated system. Use of multiple manufacturers' PVC coated products is not acceptable.

T. Conduits which emerge from within or below concrete encasement shall be PVC coated rigid galvanized steel from a minimum of 6" below to 6" above the transition point in accordance with Standard Detail E-26-0102 where the conduit is not protected by an equipment enclosure that surrounds the conduit on all sides at the point where it emerges from the encasement.

U. Aluminum conduits shall not be installed in direct contact with concrete surfaces. Where aluminum conduits are routed along concrete surfaces, they shall be installed with one-hole electro-galvanized malleable iron alloy straps with matching clamp-backs to space the conduit ¼ inch away from concrete surface. Where aluminum conduit passes through concrete, CMU or brick walls, the penetration shall be made such that the aluminum conduit does not come in contact with concrete, CMU, brick or mortar.

3.02 CONCEALED AND EMBEDDED CONDUITS

A. Conduits are permitted to be installed concealed and/or embedded with the following requirements:

1. Conduits shall not be installed horizontally when concealed within CMU walls, only vertical installation is acceptable.

2. Conduits installed embedded within concrete floors or walls shall be located so as not to affect the designed structural strength of the floor or wall. Embedded conduits shall be installed in accordance with Standard Detail S-03-0403 and ACI 318.

3. Where conduit bends emerge from concrete embedment, none of the curved portion of the bend shall be visible. Only the straight portion of the bend shall be visible. The straight portion shall emerge perpendicular to the embedment (i.e., neatly oriented 90-degrees to floor/slab/grade). Conduits that emerge in a non-perpendicular orientation are not acceptable.

4. Where multiple conduits emerge from concrete embedment or from concealment below a concrete floor, ample clear space shall be provided between conduits to allow for the appropriate and required conduit termination fittings to be installed.

5. Conduits installed embedded within concrete encasement of any kind shall be installed such that conduit couplings for parallel conduits are staggered so that they are not side by side.

B. Conduits are NOT permitted to be installed concealed and/or embedded for the following situations:

1. Conduits shall not be installed embedded within any water-bearing floors or walls.

2. Conduits shall not be installed embedded within any liquid containment area floors or walls.

3. Conduits shall not be installed concealed within CMU walls or gypsum walls that are adjacent to Class I and II hazardous areas (Division 1 and Division 2).

4. Conduits shall not be installed concealed within CMU walls or gypsum walls that are adjacent to indoor Type 1 or Type 2 chemical storage/transfer areas.

3.03 CONDUIT USES AND APPLICATIONS

A. Rigid Conduit

1. Rigid conduit for non-hazardous areas shall be furnished and installed in the materials of construction as follows:

Rigid Conduit for Non-Hazardous Areas

	Conduit Category by Wiring / Circuit Type	
Installation Area Designation / Scenario	**Power and Control**	**Instrumentation**
Exposed in indoor wet process areas	PVC coated rigid galvanized steel conduit	PVC coated rigid galvanized steel conduit
Exposed in indoor dry process areas	Rigid aluminum conduit	Rigid galvanized steel conduit
Exposed in indoor dry non-process areas	Rigid aluminum conduit	Rigid galvanized steel conduit
Exposed in indoor Type 1 chemical storage/transfer areas	PVC coated rigid galvanized steel conduit	PVC coated rigid galvanized steel conduit

Rigid Conduit for Non-Hazardous Areas

Installation Area Designation / Scenario	Conduit Category by Wiring / Circuit Type	
	Power and Control	**Instrumentation**
Exposed in indoor Type 2 chemical storage/transfer areas	Rigid aluminum conduit	PVC coated rigid galvanized steel conduit
Exposed in outdoor areas	Rigid aluminum conduit	PVC coated rigid galvanized steel conduit
Exposed within pre-fabricated electrical equipment center buildings	Electrical Metallic Tubing	Same as Power and Control
Concealed within underground concrete-encased ductbanks	Schedule 40 rigid non-metallic PVC conduit	Rigid galvanized steel conduit
Direct-buried conduits (where specifically permitted)	PVC coated rigid aluminum conduit	Rigid galvanized steel conduit
Concealed within non-elevated (i.e., "slab-on-grade" construction) concrete slabs	Schedule 40 rigid non-metallic PVC conduit	Rigid galvanized steel conduit
Concealed within elevated concrete slabs	Schedule 40 rigid non-metallic PVC conduit	Rigid galvanized steel conduit
Concealed below concrete slabs (within earth or fill material)	Schedule 40 rigid non-metallic PVC conduit	Rigid galvanized steel conduit
Concealed within concrete walls	Schedule 40 rigid non-metallic PVC conduit	Rigid galvanized steel conduit
Concealed within CMU walls	Schedule 40 rigid non-metallic PVC conduit or Electrical Metallic Tubing	Rigid galvanized steel conduit
Concealed above suspended ceilings	Electrical Metallic Tubing	Same as Power and Control
Concealed within interior walls constructed of metal studs and gypsum wall board	Electrical Metallic Tubing	Same as Power and Control
Emerging from concealment within or below a concrete floor and transitioning to exposed conduit (Reference Detail E-26-0102)	PVC coated rigid galvanized steel conduit	Same as Power and Control

2. Rigid conduit for hazardous areas shall be furnished and installed in the materials of construction as follows:

Rigid Conduit for Hazardous Areas

Installation Area Hazard / Scenario	Conduit Category by Wiring / Circuit Type	
	Power and Control	**Instrumentation**
Exposed in Class I and II areas (Division 1 and Division 2)	Rigid Galvanized Steel Conduit	Same as Power and Control
Concealed within concrete slabs in Class I and II areas (Division 1 and Division 2)	Rigid galvanized steel conduit	Same as Power and Control
Concealed below concrete slabs (within earth or fill material) in Class I and II areas (Division 1 and Division 2)	PVC coated rigid galvanized steel conduit	Same as Power and Control
Concealed within concrete walls in Class I and II areas (Division 1 and Division 2)	Rigid galvanized steel conduit	Same as Power and Control
Concealed below concrete slabs encased in at least two inches of concrete and buried 24 inches below top of slab in Class I, Division 1 areas	Schedule 40 rigid non-metallic PVC conduit	PVC coated rigid galvanized steel conduit
Concealed above suspended ceilings in Class I and II areas (Division 1 and Division 2)	Rigid Galvanized Steel Conduit	Same as Power and Control

3. The tables for the materials of construction for rigid conduits are intended to exhaustively cover all possible scenarios and installation areas under this Contract. However, if a scenario or installation area is found that is not explicitly governed by these tables, it shall be assumed for bid purposes that the conduit material of construction is to be rigid galvanized steel. This discrepancy shall be brought to the attention of the Engineer (in writing) immediately for resolution.

B. Conduit Bends

1. All conduit bends shall be the same material of construction as the rigid conduit listed in the tables above, with the following exceptions:

   a. All 90-degree bends or combinations of adjacent bends that form a 90-degree bend where concealed within concrete or below a concrete slab shall be rigid galvanized steel.

2. Field fabricated bends of metallic conduit shall be made with a bending machine and shall have no kinks. Field fabricated standard radius and long radius bends shall have minimum bending radii in accordance with the associated tables in Part 2 herein.

3. Field bending of non-metallic conduits is not acceptable, factory fabricated bends shall be used.

4. Long radius bends shall be furnished and installed for the following specific applications, all other bends shall be standard radius:

    a. All conduits containing medium voltage cable.

    b. All conduits containing fiber optic cable.

    c. All conduits containing shielded VFD cable.

    d. Where specifically indicated on the Drawings.

C. Flexible Conduit

1. Flexible conduit shall only be installed for the limited applications specified herein. Flexible conduit shall not be installed in any other application without written authorization from the Engineer. Acceptable applications are as follows:

    a. Connections to motors and engine-generator sets (and similar vibrating equipment)

    b. Connections to solenoid valves and limit switches

    c. Connections to lighting fixtures installed in suspended ceilings

    d. Connections to lighting transformers and combination power units

    e. Connections to prefabricated equipment skids

    f. Connections to HVAC equipment

    g. Connections to instrument transmitters and elements

    h. Where specifically indicated in the Standard Details

2. Flexible conduit length shall be limited per NEC, maximum. Flexible conduit shall not be installed buried or embedded within any material.

3. Unless otherwise specified herein, flexible conduits shall be installed in accordance with the Installation Guidelines published within NEMA RV-3.

4. Flexible conduit for non-hazardous areas shall be furnished and installed in the materials of construction as follows:

Flexible Conduit for Non-Hazardous Areas

Installation Area Designation / Scenario	Conduit Category by Wiring / Circuit Type	
	Power and Control	**Instrumentation**
Exposed in indoor wet process areas	Liquid-tight flexible metal conduit	Same as Power and Control
Exposed in indoor dry process areas	Liquid-tight flexible metal conduit	Same as Power and Control
Exposed in indoor dry non-process areas	Flexible metal conduit	Same as Power and Control
Exposed in indoor Type 1 chemical storage/transfer areas	Liquid-tight flexible non-metallic conduit	Same as Power and Control
Exposed in indoor Type 2 chemical storage/transfer areas	Liquid-tight flexible metal conduit	Same as Power and Control
Exposed in outdoor areas	Liquid-tight flexible metal conduit	Same as Power and Control
Concealed above suspended ceilings (all indoor areas)	Same material as exposed conduit in same area	Same as Power and Control

5. For Class I, Division 1 hazardous areas, the NEC does not permit the installation of flexible conduit. In lieu of flexible conduit in these areas, flexible conduit couplings shall be installed as specified in Part 2 herein. Flexible conduit for all other hazardous areas shall be furnished and installed in the materials of construction as follows:

Flexible Conduit for Hazardous Areas

Installation Area Hazard / Scenario	Conduit Category by Wiring / Circuit Type	
	Power and Control	**Instrumentation**
Exposed in Class I, Division 2 areas	Liquid-tight flexible metal conduit	Same as Power and Control
Exposed in Class II (Division 1 and Division 2) areas	Liquid-tight flexible metal conduit	Same as Power and Control

Flexible Conduit for Hazardous Areas

Installation Area Hazard / Scenario	Conduit Category by Wiring / Circuit Type	
	Power and Control	Instrumentation
Concealed above suspended ceilings in Class I (Division 2) and Class II (Division 1 and Division 2) areas	Same material as exposed conduit in same area	Same as Power and Control

3.04 CONDUIT FITTING USES AND APPLICATIONS

A. General

1. Conduit fittings shall be furnished and installed in the materials of construction as indicated in Part 2, herein. Conduit fitting materials of construction are dependent on the material of construction used for the associated conduit.

2. Conduit fittings shall be provided in the trade size and configuration required to suit the application.

B. Conduit Bodies

1. Conduit bodies shall be installed where wire pulling points are desired or required, or where changes in conduit direction or breaking around beams is required.

2. Where conduit bodies larger than trade size 2 inches are intended to be used as a pull-through fitting during wire installation, oversized or elongated conduit bodies shall be used. Oversized or elongated conduit bodies shall not be required if the conduit body is intended to be used as a pull-out point during wire installation.

C. Conduit Nipples and Unions

1. Conduits with running threads shall not be used in place of 3-piece couplings (unions) or close nipples. After installation of a conduit fitting of any kind, there shall be no more than ¼ inch of exposed threads visible. Factory fabricated all-thread nipples may be used between adjacent enclosures, however, the same restriction applies regarding the length of exposed threads that are visible.

D. Conduit Expansion and Deflection Fittings

1. Conduit expansion fittings shall be installed where required by the NEC and where indicated on the Drawings. Expansion fittings shall also be installed for exposed straight metallic conduit runs of more than 75 feet, in both indoor and outdoor

locations. Expansion fittings for runs of non-metallic conduit shall be installed in accordance with the NEC.

2. Conduit deflection fittings shall be installed where required by the NEC and where conduits are installed (exposed and concealed) across structural expansion joints.

3. Unless otherwise specified herein, conduit expansion and deflection fittings shall be installed in accordance with the Installation Guidelines published within NEMA FB 2.40.

E. Conduit Seals

1. Conduit seals shall be installed for conduits installed within or associated with hazardous areas and other areas as required by the NEC. In addition, conduit seals shall also be furnished and installed as follows:

a. All conduits entering or leaving enclosed areas which store or distribute chlorine gas.

b. All conduits entering or leaving enclosed areas which store or distribute sulfur dioxide gas.

c. All conduits entering or leaving enclosed air conditioned spaces.

F. Conduit Termination Fittings

1. Where conduits terminate at enclosures with a NEMA 4, 4X, or 3R rating and the enclosure does not have integral conduit hubs, an appropriately sized watertight conduit hub shall be installed to maintain the integrity of the enclosure. The use of locknuts with integral gasket in lieu of watertight conduit hubs is not acceptable.

2. Where conduits terminate at enclosures that do not require conduit hubs, a two-locknut system shall be used to secure the conduit to the enclosure. One locknut shall be installed on the outside of the enclosure, and the other inside, drawn tight against the enclosure wall. The locknut on the interior of the enclosure shall be the type with integral bonding lug, or a conduit bonding bushing may be used in place of the interior locknut.

3. Conduits shall not be installed such that conduit fittings penetrate the top of any enclosure located outdoors, except in cases where specifically required by the serving electric utility. Conduits which serve outdoor equipment or an enclosure from above shall instead be routed into the side of the enclosure at the bottom. The conduit termination fitting shall be provided with a conduit drain to divert moisture from the raceway away from the enclosure.

3.05 MISCELLANEOUS

A. Conduit Periphery Sealing

1. Unless otherwise indicated on the Drawings, below-grade conduit penetrations through exterior walls shall be sealed around the periphery using the appropriate products specified in Part 2 herein.

2. Unless otherwise indicated on the Drawings, all conduit penetrations through interior walls and floors and above-grade exterior walls shall be sealed using conduit sleeves and caulk as specified in Part 2 herein. Alternatively, where concrete or masonry walls/floors are penetrated, mortar may be used to seal around the conduit periphery for conduit penetrations through interior walls and floors and above-grade exterior walls.

3. Conduit penetrations through fire-rated walls as floors shall be made with the appropriate fire rated penetration product.

B. Conduit Interior Sealing

1. All conduits (including spares) entering a structure below grade shall be sealed on the interior of the conduit against water ingress. Sealing shall be at an accessible location in the conduit system located within the building structure and shall be via one of the methods specified in Part 2 herein. If conduit sealing cannot be achieved at an accessible location within the building structure, sealing shall be placed in the conduits in the nearest manhole or handhole outside the structure.

2. Conduit interior sealing shall not be installed until conductors inside are tested and test results are deemed acceptable by the Engineer. Conduit interior sealing shall be installed prior to energization of the conductors inside.

3.06 CONDUIT IDENTIFICATION

A. Exposed conduits shall be identified at the source, load, and all intermediate components of the raceway system. Examples of intermediate components include but are not limited to junction boxes, pull boxes, and disconnect switches. Identification shall be by means of an adhesive label with the following requirements:

1. Labels shall consist of an orange background with black text. Text for the label shall be the conduit number as indicated in the conduit and wire schedules.

2. In addition, at the source end of the conduit, a second line of text shall be included to indicate the load equipment name. This second line shall consist of the word “TO:” and the text in the ‘TO’ column of the conduit and wire schedule (e.g., TO: Raw Sewage Pump No. 1). At the load end of the conduit, a second line of text shall be included to indicate the source equipment name. This second line shall

consist of the word “FROM:” and the text in the ‘FROM’ column of the conduit and wire schedule (e.g., FROM: PANEL: PP). This requirement applies only to the source and load ends of the conduit, and not anywhere in between.

3. For conduits trade sizes 3/4 inch through 1-1/2 inch, the text shall be a minimum 18-point font. For conduits trade size 2 inch and larger, the text shall be a minimum 24-point font.

4. Label height shall be 3/4 inch minimum, and length shall be as required to fit required text. The label shall be installed such that the text is parallel with the axis of the conduit. The label shall be oriented such that the text can be read without the use of any special tools or removal of equipment.

5. Labels shall be installed after each conduit is installed and, if applicable, after painting. Labels shall be printed in the field via the use of a portable label printing system using thermal transfer technology. Handwritten labels are not acceptable.

6. Labels shall be made of permanent vinyl with adhesive backing. Labels made of any other material are not acceptable.

B. Conduits that are not exposed but installed beneath free standing equipment enclosures shall be identified by means of a plastic tag with the following requirements:

1. The tag shall be made of white Tyvek material, and have an orange label with black text, as described above, adhered to it. Text for the label shall be the conduit number as indicated in the conduit and wire schedules.

2. The tag shall be affixed to the conduit by means of a nylon cable tie. The tag shall be of suitable dimensions to achieve a minimum text size of 18 points.

C. Conduits for lighting and receptacle circuits shall not require identification.

D. Any problems or conflicts with meeting the requirements above shall immediately be brought to the attention of the Engineer for a decision.

3.07 TESTING

A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 01. The following tests are required:

1. All conduit installed below grade or concrete encased shall be tested to ensure continuity and the absence of obstructions by pulling through each conduit a swab followed by a mandrel 85% of the conduit inside diameter. After testing, all conduits shall be capped, tape is not acceptable, after installation of a suitable pulling rope.

3.08 TRAINING OF INSTALLATION PERSONNEL

A. All Contractor personnel that install PVC coated rigid metal conduit shall be trained by the PVC coated conduit manufacturer. Training shall include proper conduit system assembly techniques, use of tools appropriate for coated conduit systems, and field bending/cutting/threading of coated conduit. Training shall have been completed within the past 24 months prior to the Notice to Proceed on this Contract to be considered valid. Contractor personnel not trained within this timeframe shall not be allowed to install coated conduit or shall be trained/re-trained as required prior to commencement of conduit installation.

END OF SECTION

SECTION 26 05 33.16
BOXES FOR ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish and install all pull boxes, junction boxes, and outlet boxes as specified herein, indicated on the Drawings, and as required. Requirements for other boxes and enclosures are not necessarily included in this Section. Reference each specific equipment specification section for requirements related to that equipment's respective enclosure.

B. Reference the following Specification Sections:

1. Section 26 05 00 – Basic Electrical Requirements

2. Section 26 05 33.13 – Conduit for Electrical Systems

3. Section 26 05 53 – Identification for Electrical Systems

1.02 CODES AND STANDARDS

A. All boxes shall be Listed by and shall bear the Label of Underwriter's Laboratories, Incorporated (UL).

B. Boxes shall be designed, manufactured, and/or Listed to the following standards as applicable:

1. National Electrical Manufacturers Association (NEMA):

   a. NEMA 250 – Enclosures for Electrical Equipment.

2. National Fire Protection Association (NFPA):

   a. NFPA 70 – National Electrical Code (NEC).

3. Underwriters Laboratories (UL):

   a. UL 50 – Enclosures for Electrical Equipment, Non-environmental Considerations.

   b. UL 50E – Enclosures for Electrical Equipment, Environmental Considerations.

c. UL 514A – Metallic Outlet Boxes.

d. UL 514C – Standard for Non-metallic Outlet Boxes, Flush Device Boxes, and Covers.

e. UL 1203 – Standard for Explosion-proof and Dust-ignition-proof Electrical Equipment for use in Hazardous (Classified) Locations.

1.03 SUBMITTALS

A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01 33 00 – Submittal Procedures, the Contractor shall obtain from the equipment manufacturer(s) and submit the following:

1. Shop Drawings

B. Each submittal shall be identified by the applicable Specification Section.

1.04 SHOP DRAWINGS

A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.

B. Partial, incomplete, or illegible Submittals will be returned to the Contractor without review for resubmittal.

C. Shop drawings shall include but not be limited to:

1. Product data sheets for boxes, terminal strips, and all accessories

2. Overall bill of material for all boxes larger than 4x4 inches included under this Contract to summarize exactly what is being submitted for review. Bill of material shall at a minimum show each box type (i.e., pull junction), quantity, material of construction, dimensions, and proposed installation location.

1.05 OPERATION AND MAINTENANCE MANUALS

A. The Contractor shall submit operation and maintenance manuals in accordance with the procedures and requirements set forth in the General Conditions and Division 01.

B. As-built drawings showing dimensions, internal box layout, terminal strip information, and terminal strip identification information shall be provided for all junction boxes. As-built drawings are not required for pull boxes or outlet boxes.

1.06 IDENTIFICATION

A. Each pull and junction box shall be identified with the box name as indicated on the Contract Drawings (e.g., PPB-XXX, CJB-YYY) or as directed by the Engineer. A nameplate shall be securely affixed in a conspicuous place on each box. Nameplates shall be as specified in Section 26 05 53 – Identification for Electrical Systems.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. The equipment covered by this Specification is intended to be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be designed, constructed, and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.

2.02 PULL AND JUNCTION BOXES

A. General

1. All pull and junction boxes shall be UL Listed and Labeled.

2. Pull and junction boxes shall not be provided with eccentric or concentric knockouts.

3. Pull and junction boxes mounted embedded in concrete shall be UL Listed for embedment.

4. Where metallic boxes are used, they shall be of all welded construction. Tack welded boxes are not acceptable.

B. Pull Boxes

1. Metallic pull boxes in non-hazardous locations and in hazardous locations where general-purpose enclosures are permitted (e.g., Class I, Division 2 locations) shall be provided with a matching gasketed cover. For covers with dimensions of less than 12 inches by 12 inches, the cover shall be held in place by stainless steel machine screws. Other screw types are not acceptable. For covers with dimensions 12 inches by 12 inches and larger, the cover shall be hinged and held in place by 1/4-turn style latches. Latch mechanism shall be all stainless steel. Hinge pins shall be removable.

2. Metallic pull boxes in hazardous locations where general-purpose enclosures are not permitted (e.g., Class I, Division 1 locations) shall be provided with a matching gasketed cover. Cover shall be hinged and held in place by stainless steel bolts.

Hinge pins shall be removable. Covers shall be installed and bolts torqued in accordance with manufacturer requirements to maintain the hazardous location rating of the enclosure.

3. Non-metallic pull boxes shall be provided with a matching gasketed cover. The cover shall be hinged and held in place by quick-release (e.g., “flip”) latches. Latch material of construction shall match the box material, and include stainless steel hasps. For covers with dimensions 24 inches by 24 inches and larger, a 3-point latching mechanism with external pad-lockable handle may be substituted. Latch mechanism and handle shall be all stainless steel. Hinge pins shall be removable.

4. Pull boxes shall not have any wire terminations inside, other than those for grounding/bonding. A ground bar shall be provided with the necessary number of screw type terminals. Twenty (20) percent of the total amount of terminals otherwise required for the pull box (minimum of two) shall be provided as spare terminations. Boxes requiring any other wire terminations shall be furnished and installed in accordance with the requirements for junction boxes herein.

5. Pull boxes shall be 6 inches wide by 6 inches tall by 4 inches deep, minimum. For applications requiring larger boxes, the box shall be sized in accordance with the fill requirements and dimensional requirements of the NEC.

6. Barriers shall be provided in pull boxes to isolate conductors of different voltages, types, and functions. Barrier material of construction shall match that of the box. Isolation shall be provided between the following groups:

    a. Power wiring

    b. AC control wiring

    c. DC control wiring

    d. Instrumentation wiring

C. Junction Boxes

1. Metallic junction boxes in non-hazardous locations shall be provided with a matching gasketed cover. For covers with dimensions of less than 12 inches by 12 inches, the cover shall be held in place by stainless steel machine screws. Other screw types are not acceptable. For covers with dimensions 12 inches by 12 inches and larger, the cover shall be hinged and held in place by 1/4-turn style latches. Latch mechanism shall be all stainless steel. Hinge pins shall be removable.

2. Metallic junction boxes in hazardous locations shall be provided with a matching gasketed cover. Cover shall be hinged and held in place by stainless steel bolts.

Hinge pins shall be removable. Covers shall be installed and bolts torqued in accordance with manufacturer requirements to maintain the hazardous location rating of the enclosure.

3. Non-metallic junction boxes shall be provided with a matching gasketed cover. The cover shall be hinged and held in place by quick-release (e.g., “flip”) latches. Latch material of construction shall match the box material and include stainless steel hasps. For covers with dimensions 24 inches by 24 inches and larger, a 3-point latching mechanism with external pad-lockable handle may be substituted. Latch mechanism and handle shall be all stainless steel. Hinge pins shall be removable.

4. Barriers shall be provided in junction boxes to isolate conductors and terminal blocks of different voltages, types, and functions. Barrier material of construction shall match that of the box. Isolation shall be provided between the following groups:

    a. Power wiring

    b. AC control wiring

    c. DC control wiring

    d. Instrumentation wiring

5. Junction boxes used for lighting and receptacle circuits only shall be allowed to have screw-on (wire nut) type connectors for wire terminations/junctions.

6. Junction boxes for all uses other than lighting and receptacle circuits shall be provided with terminal strips, consisting of the necessary number of screw type terminals. Current carrying parts of the terminal blocks shall be of ample capacity to carry the full load current of the circuits connected, with a 10A minimum capacity. Terminal strips shall be rated for the voltage of the circuits connected. A separate ground bar shall be provided with the necessary number of screw type terminals. Twenty (20) percent of the total amount of terminals otherwise required for the junction box (minimum of two) shall be provided as spare terminations. When barriers are provided within the box, separate terminal strips shall be provided in each barrier area. Terminals shall be lettered and/or numbered to conform to the wiring labeling scheme in place on the project.

7. Junction boxes shall be 6 inches wide by 6 inches tall by 4 inches deep, minimum. For applications requiring larger boxes, the box shall be sized in accordance with the fill requirements and dimensional requirements of the NEC. Terminal blocks (including spare terminals) shall be considered when sizing the junction box.

D. Enclosure Types and Materials

1. In non-hazardous locations, pull and junction boxes shall be furnished with the following enclosure type and material of construction, dependent upon the designation of the area in which they are to be installed. Area designations are indicated on the Drawings.

Area Designation	Enclosure Type and Material
Indoor Wet Process Area	NEMA 4X, Type 316 Stainless Steel
Indoor Dry Process Area	NEMA 4X, Type 304 Stainless Steel
Indoor Dry Non-Process Area	NEMA 1, 304 Stainless Steel
Indoor Type 1 Chemical Storage/Transfer Area	NEMA 4X, Fiberglass or PVC
Indoor Type 2 Chemical Storage/Transfer Area	NEMA 4X, Type 316 Stainless Steel
All Outdoor Areas	NEMA 4X, Type 316 Stainless Steel

2. In hazardous locations, pull and junction boxes shall be furnished with the following enclosure type and material of construction, dependent upon the classification of the area in which they are to be installed. Area classifications are indicated on the Drawings.

Area Classification	Enclosure Type and Material
Class I, Division 1, Group D	NEMA 7, Die Cast Aluminum
Class I, Division 2, Group D	NEMA 4X, Type 304 Stainless Steel
Class II, Division 1, Group F	NEMA 9, Die Cast Aluminum
Class II, Division 2, Group F	NEMA 4X, Type 304 Stainless Steel

3. Non-metallic enclosures, NEMA 7 enclosures, and NEMA 9 enclosures shall be provided with threaded integral conduit hubs.

4. Where located outdoors or in indoor wet process areas, NEMA 7 and NEMA 9 enclosures shall also carry a NEMA 4X rating.

2.03 OUTLET BOXES

A. General

1. Outlet boxes shall be provided with a trim appropriate for the wiring device installed inside. Reference Section 26 27 26 – Wiring Devices for outlet box trim

requirements. An appropriate outlet box trim is required to achieve the NEMA rating of the outlet boxes as specified herein.

B. Surface Mount Outlet Boxes

1. Outlet boxes shall be the deep type, no less than 2.5 inches deep.

2. Outlet boxes shall be provided in single or multi-gang configuration as required, sized in accordance with the requirements of the NEC.

3. In non-hazardous locations, outlet boxes shall be furnished with the following enclosure type and material of construction, dependent upon the designation of the area in which they are to be installed. Area designations are indicated on the Drawings.

Area Designation	**Enclosure Type and Material**
Indoor Wet Process Area	NEMA 4X 316 SS
Indoor Dry Process Area	NEMA 4X 316 SS
Indoor Dry Non-process Area	NEMA 4X 316 SS
Indoor Type 1 Chemical Storage/Transfer Area	NEMA 4X 316 SS
Indoor Type 2 Chemical Storage/Transfer Area	NEMA 4X 316 SS
All Outdoor Areas	NEMA 4X 316 SS

4. In hazardous locations, outlet boxes shall be furnished with the following enclosure type and material of construction, dependent upon the classification of the area in which they are to be installed. Area classifications are indicated on the Drawings.

Area Classification	**Enclosure Type and Material**
Class I, Division 1, Group D	NEMA 7, Die Cast Aluminum
Class I, Division 2, Group D	NEMA 4X, Cast Aluminum
Class II, Division 1, Group F	NEMA 9, Die Cast Aluminum
Class II, Division 2, Group F	NEMA 4X, Cast Aluminum

5. Outlet boxes shall be provided with integral threaded conduit hubs mounted external to the box. Boxes with threaded conduit hubs mounted internal to the box or as a part of the box wall are not acceptable.

C. Flush Mount Outlet Boxes

1. Outlet boxes shall be no less than 2-1/8 inches deep, and 4-11/16 inches square. Boxes shall be UL Listed and labeled. Pre-punched single diameter conduit knockouts are acceptable; however, concentric and eccentric knockouts are not acceptable.

2. Outlet boxes mounted flush in CMU walls shall be made of galvanized, tack welded steel, and suitable for installation in masonry walls. Sectional type boxes are not acceptable for this application.

3. Outlet boxes mounted flush in gypsum walls shall be made of galvanized pressed steel. Tack welded boxes are not acceptable for this application. Sectional type boxes are not acceptable for this application.

4. Outlet boxes mounted cast into concrete shall be concrete tight and made of galvanized steel or PVC.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Pull and Junction Boxes

1. Pull boxes and junction boxes shall be solidly attached to structural members prior to installation of conduit and set true and plumb. Boxes shall not be supported by their associated conduits.

2. Wooden plugs are not permitted for securing boxes to concrete. Appropriately rated anchors specifically suited for use in concrete shall be used.

3. Box penetrations for conduits shall be made with a punch tool, and penetrations shall be of the size required for the conduit entry and/or hub. Oversized penetrations in boxes are not acceptable.

4. Watertight conduit hubs shall be provided for boxes where a NEMA 4X enclosure rating is specified. Reference Section 26 05 33.13 – Conduit for Electrical Systems for conduit hub requirements.

5. Pull and junction boxes may be installed flush mounted in gypsum, concrete, or CMU walls where appropriate provided that covers are easily removed or opened.

6. Pull and junction boxes shall be provided in the enclosure type and material of construction required for the area in which it is installed. Reference the

requirements in Part 2 herein, and the area designations indicated on the Drawings.

B. Outlet Boxes

1. Outlet boxes shall be solidly attached to structural members prior to installation of conduit and set true and plumb. Boxes shall not be supported by their associated conduits.

2. Wooden plugs are not permitted for securing boxes to concrete. Appropriately rated anchors specifically suited for use in concrete shall be used.

3. Flush mounted outlet boxes shall be arranged and located so that tile and grout lines fit closely around the boxes, and so placed that the cover or device plate shall fit flush to the finished wall surface.

4. Outlet boxes shall be flush mounted in finished areas and other areas where practical. Flush mounted outlet boxes shall not be installed in hazardous areas and type 1 or 2 chemical storage/transfer areas.

5. Depending on the type of wiring device to be installed in the outlet box, mounting heights from the finished floor or finished grade (as applicable) to the center of the box shall be as follows, unless otherwise specified herein, indicated on the Drawings, or required by the Americans with Disability Act (ADA):

   a. Light switches and wall mounted occupancy sensors, 48 inches

   b. Receptacles in indoor dry process/non-process areas, 18 inches

   c. Receptacles in indoor wet process areas and all indoor chemical storage/transfer areas, 42 inches in open areas, or 6 inches (minimum) above adjacent surfaces (e.g., countertops, tables, etc.) where applicable

   d. Receptacles in outdoor locations, 26 inches

   e. Ceiling mounted occupancy sensors, as indicated on the Drawings

   f. Flush mounted outlet boxes in CMU walls shall be adjusted to a slightly greater height than required above to align the center of the box with the center of the CMU block.

6. Outlet boxes shall be provided in the material of construction required for the area in which it is installed. Reference the requirements in Part 2 herein, and the area designations indicated on the Drawings.

END OF SECTION

SECTION 26 05 53
IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. All electrical equipment shall be properly identified in accordance with these Specifications and the Contract Drawings. All electrical equipment shall be identified in the manner described, or in an equally approved manner.

B. The types of electrical identification specified in this Section include, but are not limited to, the following:

1. Operational instructions and warnings.

2. Danger signs.

3. Equipment/system identification signs.

4. Nameplates.

1.02 SIGNS

A. "DANGER-HIGH-VOLTAGE" signs shall be securely mounted on the entry doors of all electrical rooms.

1.03 LETTERING AND GRAPHICS

A. The Contractor shall coordinate names, abbreviations, and other designations used in the electrical identification work with the corresponding designations shown, specified, or scheduled. Provide numbers, lettering, and wording as indicated or, if not otherwise indicated, as recommended by manufacturers or as required for proper identification and operation/maintenance of the electrical systems and equipment.

1.04 SUBMITTALS

A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01 33 00 – Submittal Procedures, the Contractor shall obtain from the equipment manufacturer and submit shop drawings. Each submittal shall be identified by the applicable Specification Section.

1.05 SHOP DRAWINGS

A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.

B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for resubmittal.

C. Shop drawings shall include but not be limited to:

1. Product data sheets.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. The material covered by these Specifications is intended to be standard material of proven performance as manufactured by reputable concerns. Material shall be fabricated, constructed, and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as specified herein and shown on the Drawings.

2.02 NAMEPLATES

A. Nameplates shall be engraved, high pressure plastic laminate, black foreground with white lettering.

B. Nameplates shall be attached to NEMA 4X enclosures utilizing UL-recognized mounting kits designed to maintain the overall UL Type rating of the enclosure. Mounting kit fasteners shall be stainless steel Type AHK10324X as manufactured by Hoffman, or Engineer approved equal.

2.03 HIGH VOLTAGE SIGNS

A. Standard "DANGER" signs shall be of baked enamel finish on 20 gauge steel; of standard red, black, and white graphics; 14 inches by 10 inches size except where 10 inches by 7 inches is the largest size which can be applied where needed, and except where a larger size is needed for adequate identification.

2.04 CONDUIT IDENTIFICATION

A. Conduit identification shall be as specified in Section 26 05 33.13 – Conduit for Electrical Systems.

2.05 WIRE AND CABLE IDENTIFICATION

A. Field installed wire and cable identification shall be as specified in Section 26 05 19 – Low Voltage Conductors and Cable and Section 26 05 13 – Medium Voltage Cables.

B. A plastic laminate nameplate shall be provided at each panelboard, motor control center, switchgear assembly, and switchboard assembly. This nameplate shall be used to clearly convey the conductor identification means used at that piece of equipment (i.e., Phase A=Brown, Phase B=Orange, C = Yellow).

C. Wiring identification for factory installed wiring in equipment enclosures shall be as specified in the respective Section.

2.06 BOX IDENTIFICATION

A. Pull, junction and device box identification shall be as specified in Section 26 05 33.16 – Boxes for Electrical Systems.

PART 3 – EXECUTION

3.01 NAMEPLATES

A. Nameplates shall be attached to the equipment enclosures with two (2) stainless steel sheet metal screws for nameplates up to 2-inches wide. For nameplates over 2-inches wide, four (4) stainless steel sheet metal screws shall be used, one (1) in each corner of the nameplate. The utilization of adhesives is not permitted.

3.02 OPERATIONAL IDENTIFICATION AND WARNINGS

A. Wherever reasonably required to ensure safe and efficient operation and maintenance of the electrical systems and electrically connected mechanical systems and general systems and equipment, including prevention of misuse of electrical facilities by unauthorized personnel, install plastic signs or similar equivalent identification, instruction, or warnings on switches, outlets, and other controls, devices, and covers or electrical enclosures. Where detailed instructions or explanations are needed, provide plasticized tags with clearly written messages adequate for the intended purposes. Signs shall be attached as specified above for nameplates.

3.03 POWER SOURCE IDENTIFICATION

A. After installation of all field equipment (e.g., valves, motors, fans, unit heaters, instruments, etc.) install nameplates at each power termination for the field equipment. Nameplate data shall include equipment designation (tag number), power source (MCC

number, panelboard, etc.), circuit number, conduit number from schedule and voltage/phase.

B. Contractor to coordinate with the Engineer and the Owner regarding exact nameplate placement during construction.

C. Nameplates shall be as specified herein.

END OF SECTION

SECTION 26 05 60
LOW-VOLTAGE ELECTRIC MOTORS

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish all labor, materials, tools and equipment necessary for furnishing, installing, connecting, testing and placing into satisfactory operation all low voltage electric motors as shown on the Drawings and specified herein. All motors required for this Contract shall comply with this Section unless otherwise noted.

1.02 CODES AND STANDARDS

A. Motors and related accessories shall be designed, manufactured, and/or listed to the following standards as applicable:

1. Institute of Electrical and Electronics Engineers (IEEE)

    a. IEEE 112 – Standard Test Procedure for Polyphase Induction Motors and Generators

2. National Electrical Manufacturer's Association (NEMA)

    a. NEMA MG 1 – Motors and Generators

3. Underwriters Laboratories (UL)

    a. UL 547 – Standard for Safety Thermal Protectors for Motors

    b. UL 674 – Electric Motors and Generators for Use in Hazardous (Classified) Locations

    c. UL 1004-1 – Standard for Rotating Electrical Machines

    d. UL 1004-3 – Standard for Thermally Protected Motors

    e. UL 1004-8 – Standard for Inverter Duty Motors

1.03 SUBMITTALS

A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01 33 00 – Submittal Procedures, the Contractor shall obtain from the equipment manufacturer and submit the following:

1. Shop Drawings.

2. Spare Parts List.

B. Each submittal shall be identified by the applicable Specification Section.

1.04 SHOP DRAWINGS

A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.

B. Partial, incomplete or illegible submittals will be returned to the Contractor without review for resubmittal.

C. Individual shop drawings for electric motors shall be submitted in accordance with the procedures and requirements set forth in the General Conditions and Section 01 33 00 – Submittal Procedures, unless submitted as a part of the shop drawings for the driven equipment.

D. Shop drawings for electric motors shall include motor data sheets, dimensioned drawings, wiring diagrams for devices such as space heaters, temperature devices, and shaft grounding rings. Shop drawings shall identify electric characteristics and design, mechanical construction, manufacturer's name, type and pertinent specifications for the use intended, along with the name of the equipment to be driven. For motors rated 50 horsepower or greater, submittal of motor data for acceptance shall include, as a minimum, the following:

1. Manufacturer's type and frame designation

2. Horsepower rating

3. Time rating (per NEMA Standards)

4. Ambient temperature rating

5. Motor winding insulation system designation

6. RPM at rated load

7. Frequency

8. Number of phases

9. Rated-load amperes

10. Voltage

11. Code letter (starting KVA per horsepower)

12. Design letter for integral horsepower induction motors (per NEMA Standards)

13. Service factor

14. Temperature rise at full load and at service factor load

15. Efficiency at 1/4, 1/2, 3/4 and full load

16. Power factor at 1/4, 1/2, 3/4 and full load

17. Motor outline, dimensions and weight

18. Motor winding insulation system description

19. Horsepower required by connected machine at specified conditions (load curves) shall be supplied for all compressors, propeller and positive displacement pumps.

20. The foregoing data shall also be verified after manufacture and shall be included with the information to be furnished in the operation and maintenance manuals specified.

E. The shop drawing information shall be complete and organized in such a way that the Engineer can determine if the requirements of these Specifications are being met. Copies of technical bulletins, technical data sheets from "soft-cover" catalogs, and similar information which is "highlighted" or somehow identifies the specific equipment items the Contractor intends to provide are acceptable and shall be submitted.

1.05 SPARE PARTS

A. All spare parts as recommended by the equipment manufacturer shall be furnished to the Owner by the Contractor.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. The equipment covered by this Specification is intended to be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be designed, constructed and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.

B. Electric motors shall be manufactured by Baldor/Reliance Electric Company; Nidec Motors; Toshiba Industrial and Power Systems, Inc.; Siemens Energy & Automation, Inc.; General Electric Company; or equal.

2.02 MATERIALS AND CONSTRUCTION

A. Motors shall be built in accordance with the latest standards of NEMA, including, but not limited to MG-1 and MG-2, IEEE, ANSI and to the requirements specified herein.

B. Type

1. Unless otherwise noted, motors specified herein shall be polyphase squirrel cage, NEMA Design B, or single phase capacitor or repulsion start induction motors. Special equipment requiring a motor drive with unusual characteristics shall be equipped with a definite purpose motor to meet the necessary requirements.

2. Unless otherwise shown or specified, all motors 1/2 horsepower or larger shall be three- phase, 60 Hertz, NEMA Design B, squirrel cage induction motors designed for operation at 480 volts or greater as specified herein or shown on the Drawings.

3. Unless otherwise specified in the individual equipment specification for the driven equipment, or as required by the dynamic characteristics of the load as determined by the manufacturer of the machine to be driven, all polyphase squirrel cage motors shall be designed to withstand the starting voltage shown on the Drawings and shall have torque and locked rotor current characteristics as specified for NEMA Design B motors.

4. All motors 2 horsepower and smaller shall have windings encapsulated with a flexible epoxy compound, or insulated with a flexible epoxy compound, or insulated with the manufacturer's premium quality system which shall be subject to acceptance by the Engineer.

5. All motors above 250 horsepower shall have stator windings vacuum impregnated with a polyester insulation compound.

6. Unless otherwise noted, all motors smaller than 1/2 horsepower shall be standard single-phase capacitor start or repulsion start induction type designed for operation on 120 volts or 208 volts, 60 Hz alternating current. The motor shall deliver rated load without exceeding a 40 degrees C temperature rise while operating in a 40 degrees C ambient temperature. Small fan motors less than 1/4 HP may be split-phase or shaded pole type. Shaded pole motors rated more than 1/4 horsepower are not acceptable. Fractional horsepower motors shall be completely equipped with all necessary auxiliary components for starting and labeled as "Thermally Protected". Insulation shall be Class B, except that submersible motors shall have epoxy encapsulation. Unless otherwise noted, the motors shall be

totally enclosed. Small fan motors may be of the open type where they are suitably protected from moisture dripping and lint accumulation. Motors shall be provided with sealed ball bearings lubricated for 10 years of normal use.

7. Where specified, vertical hollow-shaft motors shall be designed to carry the motors', pumps', and associated equipment's full thrust. The motors shall be equipped with grease lubricated spherical roller thrust bearings and lower radial guide bearings. Vertical hollow-shaft motors shall be fitted with non-reversing ratchet assemblies where required by equipment specifications. Vertical adjustment shall be provided by means of a lockable nut at the top of the shaft.

8. Vertical hollow-shaft motors shall have adequate thrust bearings to carry all motor loads and any other operating equipment loads. Horizontal motors shall not be installed where subjected to external thrust loads.

C. Rating

1. Each motor shall develop ample torque for its required service through its acceleration range and throughout its rated load range. The rating of the motors offered shall in no case be less than the horsepower shown on the Drawings or elsewhere specified. It should be noted that the motor sizes indicated on the Drawings or as otherwise specified herein, are motor sizes required to operate the specific equipment which is specified. Higher rated motor sizes may be determined from the actual equipment submitted, approved, purchased, and installed. Protective devices, motor starters, disconnect switches, and other necessary equipment shall be furnished and installed for the actual motor sizes required at no additional cost.

2. Motor ratings shall be based on continuous operation. The maximum temperature rise for open and drip proof type motors shall not exceed 90 degrees C, and for totally enclosed type motors shall not exceed 80 degrees C.

D. Motor Winding Insulation

1. Insulation shall be as specified for each particular type or class of motor. The insulation system shall provide a high dielectric strength, long life covering for the windings which may be required to operate in a continually damp, corrosive, and/or chemically contaminated environment. The insulation shall be resistant to attack by moisture, acids, alkalies, abrasives, and mechanical and thermal shock. Leads shall be sealed with a non-wicking, non-hydroscopic insulation material.

2. Motor insulation resistance may be checked at any time after delivery to the job site or during the warranty period. Encapsulated motor stators may be subjected to insulation testing while completely submerged in water. Any motor not meeting the

requirements specified herein will be rejected and shall be promptly replaced at no cost to the Owner.

3. Torque and locked rotor current characteristics for three phase motors shall be NEMA Design B. The locked rotor KVA/HP input at full voltage for 10 horsepower. motors and larger shall not exceed that permitted for Code Letter "J", except for specialized equipment requiring a motor drive with special definite characteristics.

4. Unless otherwise specified, non-inverter duty motors shall be furnished with a Class F insulation system. Unless otherwise specified, inverter duty motors shall be furnished with a Class H insulation system. In either case, temperature rise shall be limited to that for Class B insulation. Output torque and speed characteristics of each motor shall be suitable to operate the driven equipment through the full range of acceleration and operating load conditions without exceeding the nameplate current rating, and/or temperature rise.

E. Nameplates

1. The motor manufacturer's nameplate shall be engraved, embossed, or stamped on a stainless steel sheet and fastened to the motor frame with No. 4 or larger oval head stainless steel screws or drive pins. Printed or laser-etched nameplates are not acceptable.

2. Nameplates shall include as a minimum, Items 1 through 14 as listed in Article 1.04 D in addition to that required by NEMA standards. The nameplate shall be positioned so as to be readily visible for inspection as installed in the facility.

F. Design

1. Motors shall be designed to accelerate and drive the connected equipment under all normal operating conditions without exceeding nameplate ratings.

2. Motors specified for operation with variable frequency drives shall be inverter duty rated. Motors shall be considered inverter duty rated only if they meet all the requirements for NEMA MG-1 Part 31.

3. Motors shall be designed to output 100 percent of nameplate horsepower under continuous duty service without exceeding the temperature rise specified herein when controlled by the actual drives furnished. Inverter duty motors shall be designed to operate down to 10% of full load speed without the need for a line powered cooling fan.

4. Unless otherwise specified, electric motors shall be furnished with service factors in accordance with NEMA MG-1 as follows:

Type of Motor	Service Factor
Non-inverter Duty	1.15
Inverter Duty	1.0

5. Design selection with respect to the driven machine shall be such that the requirements do not exceed 85 percent of the motors' maximum rating modified by service factor, ambient temperature, enclosure, altitude and electrical service. The electrical service conditions shall be assumed to be 10 percent undervoltage, 5 percent underfrequency, and 3 percent voltage unbalance. Altitude shall be assumed to be the project site elevation plus 10 percent. Ambient temperature shall be assumed to be 95 degrees F in exterior locations, 104 degrees F (40 degrees C) in interior locations, and 122 degrees F (50 degrees C) within housings or enclosures; except where higher temperatures may be encountered within or on individual items of equipment. The applicable paragraphs of NEMA MG-1 shall be used in making the design selection.

6. Motors used with belt drives shall have sliding bases to provide for belt take up.

7. Terminal boxes shall be of sufficient size to accommodate the required quantity and size of conduits. Gasketed terminal boxes shall be furnished with all splash-proof and totally enclosed motors. NEMA ratings of the terminal boxes shall be suited for the application. Motors located in hazardous locations shall be furnished with terminal boxes suitable for the specific Class, Division, and Group suitable for the application. Terminal boxes shall be sized to accommodate accessory equipment such as motor differential current transformers, where required.

8. Terminal boxes for horizontal motors shall be located on the left-hand side when viewing the motor from the drive shaft end and shall be so designed that conduit entrance can be made from above, below, or either side of the terminal box.

9. Motors larger than 250hp shall be manufactured with the six stator coil leads wired to a suitably sized motor junction box for application in a differential relay scheme. Current transformers shall be provided by the motor manufacturer and installed in the factory. All ground connections and current transformer connections shall be made in the factory.

G. Construction

1. Frames, mounting means, and shafts shall meet NEMA Standards for the horsepower, RPM, and enclosure selected. Enclosures shall be selected according to the degree of mechanical protection required and shall not be of aluminum construction. All motors shall have a manufacturer's standard shop

machinery finish, consisting of a rust-resisting priming coat of zinc chromate and a finish coat of alkyd machinery enamel. Reference Section 09 90 00 – Painting.

2. Motors shall have cast iron frames and a heavy gauge steel terminal box, with neoprene gaskets between the frame and the box and between the box and its cover. A grounding lug(s) shall be provided inside the terminal box.

3. Motors weighing more than 50 pounds shall be equipped with at least one lifting eye. All lifting hardware shall be corrosion resistant.

4. Motors located in hazardous locations shall be totally enclosed and suitable for the specific Class, Division, and Group suitable for the application.

5. Motors located in Class I or II, Division 1 hazardous locations shall bear a U.L.-674 label and shall be provided with a breather/drain approved for the hazardous location. The U.L. listed breather/drain shall prevent the entrance of contaminants while allowing moisture to drain out of the motor.

6. When located outdoors, or elsewhere if specified, motors shall be totally enclosed, non-ventilated (TENV) or totally enclosed, fan-cooled (TEFC) machines, unless otherwise noted. Totally enclosed motors shall be provided with two (2) 1/4 inch drain holes drilled through the bottom of the frame, which allows complete drainage of the frame. Where specified, TEFC motors controlled by a variable frequency drive shall be provided with a separately powered cooling fan motor that runs at 60HZ to ensure proper cooling of the motor at low speeds. Cooling fan motor shall be suitable for 120VAC, single phase operation. Vertically oriented motors located outdoors shall be provided with a drip cover over the fan end to prevent accumulation of precipitation.

7. Unless otherwise specified, motors rated 100 horsepower or greater located outdoors, in unheated structures, in below grade areas, or as otherwise indicated, shall be furnished with space heaters and embedded motor winding high temperature switches with leads brought out of the motor terminal box. Space heaters shall be suitable for 120VAC operation and for a maximum surface temperature of less than 200 degrees C. Space heaters shall be of sufficient wattage to maintain the internal temperature of the motor at approximately 10 degrees C above the ambient temperature when the motor is not running.

    a. Embedded motor winding temperature switches shall operate at temperatures well below the temperature rating of the motor winding insulation system. Motor winding temperature switches are not required where other temperature monitoring devices (e.g. RTD's) are required.

8. Unless otherwise specified in the equipment specifications, motors rated 200HP or greater that are controlled by a VFD shall be furnished with resistance thermal

detectors (RTD's) embedded in the stator windings, two per phase. RTD's shall be pre-wired to terminal blocks located in a separate terminal box as specified herein.

9. Unless otherwise specified in the equipment specifications, motors rated less than 200HP that are controlled by a VFD shall be furnished with motor winding high temperature switches embedded in the stator windings with the leads brought out to the motor terminal box.

10. If so specified and when located in indoor areas which are heated and weatherproof, motors shall be open drip-proof machines. Ventilation openings shall be arranged to prevent the entrance of drops of liquid or solid particles at any angle from zero to 15 degrees downward from vertical.

11. Unless otherwise specified, or required, motors rated less than 200 horsepower shall be furnished with bearings of the grease lubricated, antifriction ball type with conveniently located grease fittings and drain plugs. A means of preventing bearings from becoming over-greased shall be provided. Bearings shall have a minimum B-10 life of 20,000 hours.

12. Rotors shall be statically and dynamically balanced. Rotor windings shall be one-piece cast aluminum. Where applicable, rotors shall be constructed with integral fins.

13. Externally mounted motor shaft grounding rings shall be provided to protect motors against motor shaft and bearing currents. Grounding rings shall be provided for all motors controlled by VFDs, with the following exceptions:

    a. Motors located in hazardous areas

    b. Motors rated less than 1 horsepower

    c. Submersible motors

14. All motors shall be provided with factory-installed one-hole terminations (ring terminals) on the ends of all motor leads. Terminations shall be identified for use with cables that have stranding other than Class B and shall be the irreversible compression type.

H. Power Factor and Efficiency

1. All motors, including vertical hollow shaft motors, in the range of 1-500 horsepower, inclusive, shall be designed specifically for energy efficiency and high power factor. The motor efficiency and power factor shall meet or exceed the values listed in the table below when the motors are tested in accordance with the NEMA preferred test method IEEE 112A, Method B, Dynamometer. Each motor shall meet the minimum guaranteed efficiency value indicated in the table below.

All tests shall be performed in accordance with the procedures contained in NEMA Standard MG1-12.58.

Table 12-11
FULL-LOAD EFFICIENCIES OF ENERGY EFFICIENT MOTORS
ENCLOSED MOTORS

HP	2 POLE		4 POLE		6 POLE		8 POLE	
	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency
1	75.5	72	82.5	80	80	77	74	70
1.5	82.5	80	84	81.5	85.5	82.5	77	74
2	84	81.5	84	81.5	86.5	84	82.5	80
3	85.5	82.5	87.5	85.5	87.5	85.5	84	81.5
5	87.5	85.5	87.5	85.5	87.5	85.5	85.5	82.5
7.5	88.5	86.5	89.5	87.5	89.5	87.5	85.5	82.5
10	89.5	87.5	89.5	87.5	89.5	87.5	88.5	86.5
15	90.2	88.5	91	89.5	90.2	88.5	88.5	86.5
20	90.2	88.5	91	89.5	90.2	88.5	89.5	87.5
25	91	89.5	92.4	91	91.7	90.2	89.5	87.5
30	91	89.5	92.4	91	91.7	90.2	91	89.5
40	91.7	90.2	93	91.7	93	91.7	91	89.5
50	92.4	91	93	91.7	93	91.7	91.7	90.2
60	93	91.7	93.6	92.4	93.6	92.4	91.7	90.2
75	93	91.7	94.1	93	93.6	92.4	93	91.7
100	93.6	92.4	94.5	93.6	94.1	93	93	91.7
125	94.5	93.6	94.5	93.6	94.1	93	93.6	92.4
150	94.5	93.6	95	94.1	95	94.1	93.6	92.4
200	95	94.1	95	94.1	95	94.1	94.1	93
250	95.4	94.5	95	94.1	95	94.1	94.5	93.6
300	95.4	94.5	95.4	94s.5	95	94.1		
350	95.4	94.5	95.4	94.5	95	94.1		
400	95.4	94.5	95.4	94.5				
450	95.4	94.5	95.4	94.5				
500	95.4	94.5	95.8	95				

Table 12-12
FULL-LOAD EFFICIENCIES FOR NEMA PREMIUM™ EFFICIENCY ELECTRIC MOTORS
RATED 600 VOLTS OR LESS (RANDOM WOUND)
OPEN MOTORS

HP	2 POLE		4 POLE		6 POLE	
	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency
1	77	74	85.5	82.5	82.5	80
1.5	84	81.5	86.5	84	86.5	81.5
2	85.5	82.5	86.5	84	87.5	81.5
3	85.5	82.5	89.5	84	88.5	86.5
5	86.5	84	89.5	84	89.5	87.5
7.5	88.5	86.5	91	89.5	90.2	88.5
10	89.5	87.5	91.7	90.2	91.7	90.2
15	90.2	88.5	93	91.7	91.7	90.2
20	91	89.5	93	91.7	92.4	91
25	91.7	90.2	93.6	92.4	93	91.7
30	91.7	90.2	94.1	93	93.6	92.4
40	92.4	91	94.1	93	94.1	93
50	93	91.7	94.5	93.6	94.1	93
60	93.6	92.4	95	94.1	94.5	93.6
75	93.6	92.4	95	94.1	94.5	93.6
100	93.6	92.4	95.4	94.5	95	94.1
125	94.1	93	95.4	94.5	95	94.1
150	94.1	93	95.8	95	95.4	94.5
200	95	94.1	95.8	95	95.4	94.5
250	95	94.1	95.8	95	95.4	94.5
300	95.4	94.5	95.8	95	95.4	94.5
350	95.4	94.5	95.8	95	95.4	94.5
400	95.8	95	95.8	95	95.8	95
450	95.8	95	96.2	95.4	96.2	95.4
500	95.8	95	96.2	95.4	96.2	95.4

NOTES:

(Motor data for continuous duty, NEMA Design B, 1.15 service factor, 40 degrees Celsius ambient, Class F insulation, 3 phase, 460 volt, at listed speed rating.

(TEFC efficiencies apply to both horizontal and vertical motors.

2. Motors rated 50 horsepower or greater shall be individually tested at the factory before shipment, with a copy of test results provided for the Engineer, to assure compliance with the efficiency and power factor specifications.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Motors shall be installed as shown on the Drawings and in accordance with the manufacturer's installation instructions.

3.02 DELIVERY, STORAGE, AND HANDLING

A. Motors shall be properly protected from weather hazards. Motors shall not be allowed to be wrapped tightly in plastic while outdoors. Motors delivered to the site which will not be put in service for a time in excess of 30 calendar days, whether in storage or installed, shall have the shafts rotated a minimum of five (5) rotations every 30 days.

B. Motors provided with space heaters shall have temporary power applied to the heaters no later than 30 calendar days after delivery to the site until permanent power can be applied to the heaters.

C. Motors that, in the opinion of the Engineer, have not been properly protected shall be inspected by the manufacturer's representative. Any required electrical corrections for testing shall be made at the Contractor's expense prior to acceptance and/or use.

D. All motors shall operate without any undue noise or vibration and shall show no signs of phase unbalance.

3.03 TESTING

A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 01. The following tests are required:

1. Witnessed Shop Tests

a. All motors shall be shop tested and inspected in accordance with the equipment manufacturer's standard procedures. Shop tests for motors 100 horsepower and larger may be witnessed by the Engineer. The manufacturer's testing and inspection procedures shall demonstrate that the equipment tested conforms to the requirements specified, all other applicable requirements, and shall be approved by the Engineer. At least 10 days’ notice shall be given the Engineer prior to tests and inspection dates.

b. In addition to the efficiency and power factor testing specified herein, each motor shall be tested to determine compliance with the applicable requirements of the IEEE, ANSI and NEMA. Tests shall be as follows:

1) Motors less than 50 HP:

a) Each motor shall be subjected to a standard, short commercial test including the following:

i. Running current, no load

ii. Locked rotor current

iii. High potential

iv. Winding resistance

v. Bearing inspection

2) Motors between 50 and 100 HP

a) Each motor shall be subjected to the above tests and shall be furnished with certified test results.

3) Motors larger than 100 HP

a) Each motor shall be furnished with certified test results. Each motor shall be subjected to a complete test consisting of full load heat run, percent slip, running load current, locked rotor current, breakdown torque (calculated), starting torque, winding resistance, high potential, secondary current and voltage at collector rings (wound rotor), efficiencies at 100, 75 and 50 percent of full load, power factors at 100, 75 and 50 percent of full load and bearing inspection. Tests will be witnessed by the Engineer where specifically indicated.

4) Test Reports

a) All test results for motors over 100 horsepower shall be submitted to the Engineer for approval. Copies of witnessed test raw data shall be submitted to the Engineer immediately upon completion of such tests.

2. Field Tests

a. Field tests shall be performed in accordance with the requirements specified in the General Conditions, Division 01, and Section 26 05 00 – Basic Electrical Requirements.

b. All electric motors furnished for this project one (1) horsepower or larger shall have the information required in the following tabulation completed. See Exhibit "A" on following page.

c. All field testing shall be witnessed by the Engineer.

(EXHIBIT A)

MOTOR TEST RECORD					
Motor Identification Remarks	**Location**	**Specified Horsepower**	**Nameplate Horsepower**	**Nameplate Amperage (FLA)**	**Measured Amperage Under Normal Operating Conditions**

END OF SECTION

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SECTION 26 09 16
ELECTRIC CONTROLS AND RELAYS

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish, install, test, and place in satisfactory operation all electric controls and relays as specified herein and indicated on the Drawings.

B. Electrical control and relay systems shall be assembled using NEMA rated components. Components designed and built to International Electrotechnical Commission (IEC) standards are not recognized. Equipment designed, manufactured, and Labeled in compliance with IEC standards is not acceptable.

C. Reference the following Specification Sections:

1. Section 26 05 00 – Basic Electrical Requirements

2. Section 26 05 53 – Identification for Electrical Systems

1.02 CODES AND STANDARDS

A. Products specified herein shall be designed, manufactured, and/or Listed to the following standards as applicable:

1. American National Standards Institute (ANSI)/International Society of Automation (ISA):

a. ANSI/ISA 12.12.01 – Nonincendive Electrical Equipment for Use in Class I and II, Division 2 and Class III, Divisions 1 and 2 Hazardous (Classified) Locations.

2. National Electrical Manufacturers Association (NEMA):

a. NEMA 250 – Enclosures for Electrical Equipment.

3. National Fire Protection Association (NFPA):

a. NFPA 70 – National Electrical Code (NEC).

4. Underwriters Laboratories (UL):

a. UL 508A – Standard for Industrial Control Panels.

b. UL-1203 – Standard for Explosion-proof and Dust-ignition-proof Electrical Equipment for use in Hazardous (Classified) Locations.

1.03 SUBMITTALS

A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01 33 00 – Submittal Procedures, the Contractor shall obtain from the equipment manufacturer and submit the following:

1. Shop Drawings

2. Spare Parts List

B. Each submittal shall be identified by the applicable Specification Section.

1.04 SHOP DRAWINGS

A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.

B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for resubmittal.

C. Shop drawings shall include but not be limited to:

1. Product data sheets.

D. The shop drawing information shall be complete and organized in such a way that the Engineer can determine if the requirements of these Specifications are being met. Copies of technical bulletins, technical data sheets from "soft-cover" catalogs, and similar information which is "highlighted" or somehow identifies the specific equipment items the Contractor intends to provide are acceptable and shall be submitted.

1.05 SPARE PARTS

A. All spare parts as recommended by the equipment manufacturer shall be furnished to the Owner by the Contractor. In addition to the manufacturer recommended spare parts, the following spare parts shall be provided for the local control stations:

1. One (1) contact block of each type furnished on the project

2. One (1) indicating light lens of each color furnished on the project

3. One (1) LED lamp of each color furnished on the project

B. Reference Section 26 05 00 – Basic Electrical Requirements for spare parts delivery and handling requirements.

PART 2 – PRODUCTS

2.01 CONTROL COMPONENTS

A. Manufacturers

1. Control components shall be manufactured by Eaton, The Square D Company, GE by ABB, Allen-Bradley, Siemens Energy and Automation, or Engineer approved equal.

B. Pilot Devices

1. General

a. All pilot devices shall be provided with a legend plate. Legend plates shall have a white background and black lettering and indicate the function of the respective pilot device. The text shown on the Drawings or indicated in the specifications shall be used as the basis for legend plate engraving (e.g., HAND-OFF-AUTO, RUN, EMERGENCY STOP, etc.).

b. All pilot devices shall be selected and properly installed to maintain the NEMA 250 rating of the enclosure in which they are installed. All pilot devices shall be UL 508 Listed.

c. All pilot devices shall be 30.5mm in diameter, unless otherwise indicated. 22mm devices are not acceptable.

d. Pilot devices for all electrical equipment under this Contract shall be of the same type and manufacturer unless otherwise specified herein or indicated on the Drawings.

e. In Class 1 Division 2 hazardous locations, pilot devices shall be the hermetically-sealed type, constructed in accordance with ANSI/ISA 12.12.01.

2. Pushbuttons

a. Pushbuttons shall be non-illuminated, black in color, and have momentary style operation unless otherwise indicated on the Drawings.

b. Pushbuttons shall have the quantity of normally closed and/or normally open contacts as indicated on the Drawings and as required. In addition to the required contacts, one (1) spare normally open and one (1) spare normally closed contact shall be installed at each pushbutton. Contacts shall be rated for 5A at 250VAC/DC (minimum), but no less than required for the application.

c. Pushbuttons shall be provided with a full guard around the perimeter of the button. Where a lockout style pushbutton is specified or indicated on the Drawings, provide a padlockable guard.

3. Selector Switches

a. Selector switches shall be non-illuminated, black in color, and have the number of maintained positions as indicated on the Drawings and as required. Handles shall be the extended type that provide a greater surface area for operation.

b. Selector switches shall have the quantity of normally closed and/or normally open contacts as indicated on the Drawings and as required. In addition to the required contacts, one (1) spare normally open and one (1) spare normally closed contact shall be installed at each selector switch. Contacts shall be rated for 5A at 250VAC/DC (minimum), but no less than required for the application.

c. Where indicated in the Drawings or Specifications, provide spring return positions.

d. Selector switches shall be provided with an indexing component that fits into the keyed portion of the cutout for the device and prevents the switch from spinning when operated.

4. Indicating Lights

a. Indicating lights shall be LED type, with the proper voltage rating to suit the application, and push-to-test feature.

b. Indicating light lens colors shall be as required in equipment specifications and/or as indicated on the Drawings. If lens colors are not indicated, the following colors shall be used:

Color	Designation
Red	"Run", "On", “Open”

Green	"Off", “Closed”, “Ready”
Amber	"Alarm", "Fail"
White	“Control Power On”

5. Emergency Stop and Tagline Switches

    a. Emergency stop switches shall be non-illuminated, red in color, with a minimum 35mm diameter mushroom head. Once activated, switch shall maintain its position and require a manual pull to release/reset.

    b. Tagline switches shall have a plunger that activates upon tension from the associated safety cable. Once activated, switch shall maintain its position and require a manual release/reset.

    c. Emergency stop and tagline switches shall have the quantity of normally closed and/or normally open contacts as indicated on the Drawings and as required. In addition to the required contacts, one (1) spare normally open and one (1) spare normally closed contact shall be installed at each switch. Contacts shall be rated for 5A at 250VAC/DC (minimum), but no less than required for the application.

C. Relays and Timers

1. General

    a. Relays and timers shall be furnished with an integral pilot light for positive indication of coil energization and shall have a manual operation integral button

    b. Relays and timers for all electrical equipment under this Contract shall be of the same type and manufacturer unless otherwise specified herein or indicated on the Drawings.

2. Control and Pilot Relays

    a. Relays shall have a clear or translucent housing that allows the contacts to be visually inspected without disassembly.

    b. Relays shall have coil voltage as required to suit the application and/or as indicated on the Drawings.

    c. Relays shall be provided with contacts rated for 10A (resistive), minimum, at 120/240 VAC and 28 VDC. Relays shall have 3-pole, double-throw (3PDT) contact arrangement.

3. Time Delay Relays

    a. Timers delay relays shall utilize electronic timing technology. Mechanical timing devices are not acceptable.

    b. Relays shall have coil voltage as required to suit the application and/or as indicated on the Drawings.

    c. Relays shall be provided with contacts rated for 10A (resistive), minimum, at 120/240 VAC and 28 VDC. Relays shall have double-pole double-throw (DPDT) contact arrangement.

    d. Time delay ranges shall be as indicated on the Drawings and/or as required to suit the application. Timing range shall be adjustable from the front of the relay. On delay and off delay timer configurations shall be provided as indicated on the Drawings and/or as required to suit the application.

4. Elapsed Time Meters

    a. Elapsed time meters shall be non-resettable type with no less than a five (5) digit display. Coil voltage shall be as required to suit the application and/or as indicated on the Drawings.

D. Control Terminal Blocks

1. Control terminal blocks shall be assembled on non-current carrying galvanized steel DIN mounting rails securely bolted to the enclosure or subpanel. Terminals shall be tubular screw type with pressure plate that will accommodate wire size range of #22 – #8 AWG.

2. Control terminal blocks shall be single tier with a minimum rating of 600 volts and 20A. Separate terminal strips shall be provided for each type of control used (e.g., 120VAC vs. 24VDC). Quantity of terminals shall be provided as required to suit the application. In addition, there shall be a sufficient quantity of terminals for the termination of all included spare conductors. A minimum of 10% terminals of each signal type shall be provided for future terminations.

3. Terminals shall be marked with a permanent, continuous marking strip, with each terminal numbered. One side of each terminal shall be reserved exclusively for incoming field conductors. Common connections and jumpers required for internal wiring shall not be made on the field side of the terminal.

2.02 LOCAL CONTROL STATIONS

A. Local control stations shall be furnished and installed complete with pushbuttons, selector switches, indicating lights, and other devices as indicated on the Drawings.

B. Specific devices installed in local control stations shall be provided in accordance with the requirements specified elsewhere in this Section.

C. In non-hazardous locations, local control stations shall be furnished with the following enclosure type and material of construction, dependent upon the designation of the area in which they are to be installed. Area designations are indicated on the Drawings.

Area Designation	Enclosure Type and Material
Indoor Wet Process Area	NEMA 4X, Type 316 Stainless Steel
Indoor Dry Process Area	NEMA 12, Type 304 Stainless Steel
Indoor Dry Non-process Area	NEMA 12, Type 316 Stainless Steel
Indoor Type 1 Chemical Storage/Transfer Area	NEMA 4X, Fiberglass or Thermoplastic Polyester
Indoor Type 2 Chemical Storage/Transfer Area	NEMA 4X, Type 304 Stainless Steel
All Outdoor Areas	NEMA 4X, Type 304 Stainless Steel

D. In hazardous locations, local control stations shall be furnished with the following enclosure type and material of construction, dependent upon the classification of the area in which they are to be installed. Area classifications are indicated on the Drawings.

Area Classification	Enclosure Type and Material
Class I, Division 1, Group D	NEMA 7, Die Cast Aluminum
Class I, Division 2, Group D	NEMA 4X, Type 316 Stainless Steel
Class II, Division 1, Group F	NEMA 9, Die Cast Aluminum
Class II, Division 2, Group F	NEMA 9, Die Cast Aluminum

E. Non-metallic enclosures, NEMA 7 enclosures, and NEMA 9 enclosures shall be provided with threaded integral conduit hubs. Conduit hubs shall be external to the enclosure. Where located outdoors or in indoor wet process areas, NEMA 7 and NEMA 9 enclosures shall also carry a NEMA 4X rating.

F. Local control stations for use in non-hazardous locations shall be UL-508 Listed. Local control stations for use in Class I, Division 1 and Class II, Divisions 1/2 hazardous locations shall be UL-1203 Listed. Local control stations for use in Class I, Division 2 hazardous locations shall be in accordance with ANSI/ISA 12.12.01-2013.

G. Provide a nameplate on each local control station in accordance with Section 26 05 53 – Identification for Electrical Systems. The name and/or number of the equipment

associated with each control station shall be engraved on the nameplate, followed by the words “LOCAL CONTROL STATION”.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Local control stations shall be provided in the enclosure type and material of construction required for the area in which it is installed. Reference the requirements in Part 2 herein, and the area designations indicated on the Drawings.

B. Local control stations shall be mounted, nominally, at 4ft 6in above finished floor or finished grade to the centerline of the enclosure, at the equipment height where appropriate and permitted by the NEC, or as shown otherwise on the Drawings.

C. All control components shall be mounted in a manner that will permit servicing, adjustment, testing, and removal without disconnecting, moving, or removing any other component. Components mounted on the inside of panels shall be mounted on removable plates and not directly to the enclosure. Mounting shall be rigid and stable unless shock mounting is required otherwise by the manufacturer to protect equipment from vibration. Component's mounting shall be oriented in accordance with the component manufacturer's and industries' standard practices.

D. Pilot devices shall be properly bonded to the equipment enclosure door where they are installed. If proper bonding cannot be achieved through the locknuts that affix the device in place, a green colored bonding screw shall be provided on the pilot device. The device shall be bonded to the equipment enclosure with an insulated green bonding conductor.

E. Local control station covers shall be bonded to the local control station enclosure with an insulated green bonding conductor.

F. Wiring to devices at each local control station shall be provided with enough slack to permit the local control station cover to be removed and pulled at least 6 inches away from the enclosure.

END OF SECTION

SECTION 26 22 00
LOW VOLTAGE TRANSFORMERS

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish, install, test, and place in satisfactory operation transformers for power and lighting distribution systems as specified herein, as indicated on the Drawings, and as required to complete the electrical installations.

B. Reference the following Specification Sections:

1. Section 26 05 00 – Basic Electrical Requirements

2. Section 26 05 53 – Identification for Electrical Systems

C. All equipment specified in this Section shall be furnished by the transformer manufacturer who shall be responsible for the suitability and compatibility of all included equipment.

1.02 CODES AND STANDARDS

A. All equipment shall be Listed by and shall bear the Label of Underwriter's Laboratories, Incorporated (UL).

B. Transformers shall be designed, manufactured, and/or Listed to the following standards as applicable:

1. American National Standards Institute (ANSI)/Institute of Electrical and Electronic Engineers (IEEE):

a. ANSI/IEEE C57.12.01 – Standard for General Requirements for Dry -Type Distribution and Power Transformers.

2. National Electrical Manufacturers Association (NEMA):

a. NEMA ST 20 – Dry Type Transformers for General Applications.

3. National Fire Protection Association (NFPA):

a. NFPA 70 – National Electrical Code (NEC).

4. Underwriters Laboratories (UL):

a. UL 1561 – Dry-Type General Purpose and Power Transformers.

5. U.S. Department of Energy 2016 Efficiency Standards

1.03 SUBMITTALS

A. In accordance with the procedures and requirements set forth in the General Conditions and Division 01, the Contractor shall obtain from the equipment manufacturer and submit the following:

1. Shop Drawings.

2. Operation and Maintenance Manuals.

3. Spare Parts List.

4. Reports of Certified Shop Field Tests.

B. Each submittal shall be identified by the applicable Specification Section.

1.04 SHOP DRAWINGS

A. Each submittal shall be complete in all respects, incorporating all information and data listed herein, and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.

B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for resubmittal.

C. Shop drawings shall include but not be limited to:

1. Product data sheets.

2. Drawings showing clearly marked dimensions and weight for each transformer.

3. Sample equipment nameplate diagram.

D. The submittal information shall reflect the specific equipment identification number as indicated on the Drawings (e.g., TX-LP-DWB).

E. The shop drawing information shall be complete and organized in such a way that the Engineer can determine if the requirements of these Specifications are being met. Copies of technical bulletins, technical data sheets from "soft-cover" catalogs, and similar information which is "highlighted" or somehow identifies the specific equipment items that the Contractor intends to provide are acceptable and shall be submitted.

1.05 OPERATION AND MAINTENANCE MANUALS

A. The Contractor shall submit operation and maintenance manuals in accordance with the procedures and requirements set forth in the General Conditions and Division 01.

1.06 IDENTIFICATION

A. Each transformer shall be identified with the equipment item number indicated on the Contract Drawings and the accepted Shop Drawings. A nameplate shall be securely affixed in a conspicuous place on each transformer. Nameplates shall be as specified in Section 26 05 53 – Identification for Electrical Systems.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. The equipment covered by this Specification is intended to be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be designed, constructed, and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.

B. Dry type distribution transformers shall be Energy Star compliant and manufactured by the Square D Company, GE by ABB, Eaton, or Siemens Energy and Automation, Inc.

2.02 DRY TYPE TRANSFORMERS

A. Furnish and install single-phase and three-phase general purpose, dry-type transformers, as specified herein and indicated on the Drawings. The transformers shall be 60 Hz, self-cooled, quiet-design insulated of the two-winding type.

B. The transformers shall be UL 1561 Listed.

C. The primary windings shall be rated 480 VAC for use on 3-phase systems and connected delta unless indicated otherwise on the Drawings. KVA ratings shall be as shown on the Drawings. Furnish transformers with two 2-1/2% primary taps above, and four 2-1/2% primary taps below rated voltage for transformers 15 KVA and above, and two 2-1/2% primary taps above, and two 2-1/2% primary taps below rated voltage for transformers less than 15 kVA. All taps shall be full capacity rated.

D. The ratings of the secondary windings shall be as indicated on the Drawings.

E. Transformers shall be designed for continuous operation at rated KVA, 24 hours a day, 365 days a year, with normal life expectancy as defined in ANSI/IEEE C57.96. This performance shall be obtainable without exceeding 150 degrees Celsius average temperature rise by resistance or 180 degrees Celsius hot spot temperature rise in a 40

degrees Celsius maximum ambient and 30 degrees Celsius average ambient. The maximum coil hot spot temperature shall not exceed 220 degrees Celsius. All insulating materials shall be flame retardant and shall not support combustion as defined in ASTM Standard Test Method D 635. All insulating materials shall be in accordance with NEMA ST 20 Standard for a 220 degrees Celsius UL component recognized insulation system.

F. Transformer coils shall be of the continuous wound construction and shall be impregnated with non-hygroscopic, thermosetting varnish.

G. All cores are to be constructed of high grade, non-aging, grain-oriented silicon steel with high magnetic permeability and low hysteresis and eddy current losses. Magnetic flux densities are to be kept well below the saturation point. The core laminations shall be tightly clamped and compressed with structural steel angles. The completed core and coil shall then be bolted to the base by means of vibration-absorbing mounts to minimize sound transmission. There shall be no metal-to-metal contact between the core and coil assembly and the enclosure.

H. All transformers shall be equipped with a wiring compartment suitable for conduit entry and large enough to allow convenient wiring. The maximum temperature of the enclosure shall not exceed 90 degrees Celsius. Transformers shall be furnished with lugs of the size and quantity required and suitable for termination of the field wiring.

I. The core of the transformer shall be visibly grounded to the enclosure by means of a flexible grounding conductor sized in accordance with applicable NEMA, IEEE, and ANSI standards.

J. Transformers shall have core and coil assemblies mounted on rubber isolation pads to minimize the sound levels. Transformers shall not exceed the sound levels listed in NEMA ST-20.

K. Transformers shall be furnished with the following enclosure type and material of construction, dependent upon the designation of the area in which they are to be installed. Area designations are indicated on the Drawings.

Area Designation	**Enclosure Type and Material**
Indoor Wet Process Area	NEMA 3R, 316 Stainless Steel
Indoor Dry Process Area	NEMA 2, Painted Steel
Indoor Dry Non-Process Area	NEMA 2, Painted Steel
All Outdoor Areas	NEMA 3R, 316 Stainless Steel

L. Painted steel enclosures shall be made of heavy gauge steel and shall be degreased, cleaned, primed, and finished with a baked weather-resistant enamel using the manufacturer's standard painting process. Color shall be ANSI 49 or 61 grey.

PART 3 – EXECUTION

3.01 INSTALLATION

A. The transformers shall be furnished and installed as shown on the Drawings and as recommended by the equipment manufacturer.

B. Conduit routed to and from the transformer shall be arranged for easy removal of the transformer access covers.

C. Where transformers 50 kVA and smaller are shown to be wall mounted, a transformer manufacturer supplied wall mounting kit shall be used. The lowest point of the wall mounting bracket shall be no lower than 7'-0" above the finished floor. Field fabricated mounting hardware is not acceptable unless reviewed and approved in writing by the Engineer.

D. Prior to final completion of the work, all metal surfaces of the equipment shall be cleaned thoroughly, and all scratches and abrasions shall be retouched with the same lacquer as used for shop finishing coats.

3.02 TESTING

A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 01. The following tests are required:

1. Certified Shop Tests

a. The transformers shall be given routine factory tests in accordance with the requirements of the ANSI and NEMA standards. Temperature rises may be certified from basic design.

b. As a minimum, the following tests shall be made on all transformers:

1) Ratio tests on the rated voltage connection and on all tap connections.

2) Polarity and phase-relation tests on the rated voltage connection.

3) Applied potential tests.

4) Induced potential tests.

5) No-load and excitation current at rated voltage on the rated voltage connection.

2. Field Tests

a. Field testing shall be done in accordance with the requirements specified in the General Conditions, Division 01, and NETA Acceptance Testing Specifications, latest edition.

b. Insulation between windings shall be tested by 1000 VDC Megohmmeter for one (1) minute. Resistance value shall be no less than 100 Megaohms.

END OF SECTION

SECTION 26 24 16
PANELBOARDS

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish, install, test, and place in satisfactory operation panelboards as specified herein and indicated on the Drawings. Panelboards shall be furnished with circuit breaker ratings, number of breakers, number of poles, and arrangements/locations conforming to the panelboard schedules shown on the Drawings.

B. Reference the following Specification Sections:

1. Section 26 05 00 – Basic Electrical Requirements

2. Section 26 05 53 –Identification for Electrical Systems

3. Section 26 43 13 – Surge Protective Devices

1.02 CODES AND STANDARDS

A. All equipment shall be Listed by and shall bear the Label of Underwriter's Laboratories, Incorporated (UL).

B. The equipment shall be designed, manufactured, and/or Listed to the following standards as applicable:

1. National Electrical Contractors Association (NECA):

   a. NECA 407 – Standards for Installing and Maintaining Panelboards.

2. National Electrical Manufacturers Association (NEMA):

   a. NEMA PB 1 – Panelboards.

3. National Fire Protection Association (NFPA):

   a. NFPA 70 – National Electrical Code (NEC).

4. Underwriters Laboratories (UL):

   a. UL 50 – Enclosures for Electrical Equipment, Non-environmental Considerations.

b. UL 67 – Standard for Panelboards.

c. UL 489 – Molded Case Circuit Breakers, Molded Case Switches, and Circuit Breaker Enclosures.

d. UL 943 – Ground Fault Circuit Interrupters.

1.03 SUBMITTALS

A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01 33 00 – Submittal Procedures, the Contractor shall obtain from the equipment manufacturer and submit the following:

1. Shop Drawings.

2. Spare Parts List.

3. Operation and Maintenance Manuals.

4. Reports of Field Tests.

B. Each submittal shall be identified by the applicable Specification Section.

1.04 SHOP DRAWINGS

A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.

B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for resubmittal.

C. Shop drawings shall include but not be limited to:

1. Product data sheets.

2. Complete assembly, layout, and installation drawings with clearly marked dimensions for each panelboard.

3. Complete panelboard schedules indicating circuit designations as shown on the Drawings for each panelboard.

4. The submittal information shall reflect the specific equipment identification number as indicated on the Drawings (e.g., LP-1, PP-2, etc.).

1.05 OPERATIONS AND MAINTENANCE MANUALS

A. The Contractor shall submit operation and maintenance manuals in accordance with the procedures and requirements set forth in the General Conditions and Division 01. The manuals shall include:

1. Instruction books and/or leaflets.

2. Recommended spare parts list.

3. Final as-built construction drawings included in the shop drawings incorporating all changes made in the manufacturing process and during field installation.

1.06 SPARE PARTS

A. For each panelboard, the Contractor shall furnish to the Owner all spare parts as recommended by the equipment manufacturer. All spaces in the panelboards shall be furnished with a spare breaker as indicated in the panelboard schedules shown on the Drawings.

A. Reference Section 26 05 00 – Basic Electrical Requirements for spare parts delivery and handling requirements.

1.07 IDENTIFICATION

A. Each panelboard shall be identified with the identification name/number indicated on the Drawings. A nameplate shall be securely affixed in a conspicuous place on each panelboard. Nameplates shall be as specified in Section 26 05 53 – Identification for Electrical Systems.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. The Equipment shall be designed, constructed, and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.

B. It is the intent of these specifications that the panelboards be produced by a single manufacturer who shall be responsible for matching all components and providing equipment which functions together as a system.

C. Power panelboards, those identified with prefix “PP” on the Drawings, shall be the PRL3X Series by Eaton, NF Series by Square D, GE by ABB equivalent, or Siemens Energy and Automation, Inc. equivalent.

D. Lighting and instrument panelboards, those identified with prefix “LP” and “IP” respectively on the Drawings, shall be the PRL1X or PRL2X Series by Eaton, NQ Series by Square D, GE by ABB equivalent, or Siemens Energy and Automation, Inc. equivalent.

2.02 PANELBOARDS

A. General

1. Panelboards shall be dead-front type and shall be of the configuration and rating as specified herein and indicated on the Drawings. Panelboards shall be UL 67 Listed and shall be constructed to NEMA PB1 standards.

2. Where specified herein, indicated on the Drawings, or required, panelboards shall be rated for service entrance and bear a service entrance label.

3. Panelboards shall be equipped with a main circuit breaker or main lugs complete with branch circuit breakers, as indicated on the Drawings. The panelboards shall be suitable for flush or surface mounting as indicated on the Drawings.

4. Panelboards shall be fully rated and shall have a minimum short circuit rating of 22,000 amperes symmetrical for units rated 240VAC and below, and 42,000 amperes symmetrical for units rated above 240VAC, unless otherwise indicated on the Drawings.

B. Enclosures

1. Enclosures shall be UL 50 Listed and have a NEMA rating as indicated on the Drawings. An Underwriter's Laboratories, Inc. inspection label shall appear on the interior of the cabinet. Enclosures designated as NEMA 4X shall be constructed of 304 stainless steel. Enclosures with all other NEMA ratings shall be constructed of No. 12 U.S.S. code gauge galvanized steel, painted ANSI 49 or 61 gray. The enclosure shall have wiring gutters on the sides and shall be at least 5-3/4 inches deep. Wiring gutters shall be large enough to allow compliance with NEC minimum bending radius requirements for all cables to be terminated, including future cables sized for any spare circuit breakers that are shown on the Drawings.

2. All panelboards shall be provided with a dead front style trim. Additional trim requirements are as follows:

a. Distribution panelboards with enclosures that are rated other than NEMA 12 shall have hinged covers over each vertical wiring gutter to allow access to all branch mounted device terminations without removing the panel trim.

b. Power, lighting, and instrumentation panelboards with enclosures that are rated other than NEMA 12 shall be provided with a full height hinge where it

is attached to the panelboard box. Trim shall be attached to the panelboard enclosure using concealed trim clamps. Resultant trim assembly shall allow work inside the enclosure without the need to remove the panel trim from the enclosure.

Panelboard trim shall include a door over the dead front area to provide access to the circuit breakers and other devices. The access door shall be fastened to the trim with concealed hinges and be equipped with flush-type catches. Access doors exceeding 40 inches in height shall be equipped with a vertical bolt three-point locking mechanism, all other doors shall have a single-point mechanism. All locks shall be keyed alike.

3. The panelboard shall be provided with an information label. The information label shall include the panelboard designation, voltage, phase, number of wires, and bus ratings.

C. Bus Work

1. Where 3-wire bus is indicated on the Drawings, the panelboard shall be furnished with 3 phase busses and a ground bus. In addition, if a transformer with a grounded wye secondary is shown on the Drawings to be supplying a 3-wire panelboard, a neutral landing pad shall be furnished within the panelboard to provide a place to terminate the grounded conductor. Providing a 4-wire bus (3 phases plus neutral) for a 3-wire system is not acceptable.

2. Where a 4-wire bus is indicated on the Drawings, the panelboard shall be furnished with 3 phase busses, a neutral bus of equal ampacity to the phase bus, and a ground bus.

3. Main bus bars shall be of ample size so that a current density of not more than 1000 amperes per square inch of cross section will be attained. This current density shall be based on the application of the full load connected to the panel plus approximately 25% of the full load for spare capacity. The main bus shall be full capacity as based on the preceding for the entire length of the panel to provide full flexibility of circuit arrangement.

4. A separate ground bus shall be provided with lugs for termination of equipment grounding conductors.

5. Branch bus work shall be rated to match the maximum branch circuit breaker which may be installed in the standard space.

6. Bus shall be tin-plated copper and shall extend the entire useable length of the panelboard, including spaces.

7. Where required by the NEC, a bonding jumper, sized in accordance with the NEC, shall be installed between the panelboard ground bus and the neutral bus or neutral landing pad.

D. Circuit Breakers

1. Main and branch circuit breakers shall be bolt-on, UL 489 Listed molded-case type with trip ratings as indicated on the Drawings. Unless otherwise indicated, circuit breakers shall be manually operable, with automatic trip-free operation, and shall provide inverse-time-limit overload and instantaneous short-circuit protection. All circuit breakers shall have quick-make, quick-break, toggle mechanisms for manual as well as automatic operation.

2. Main circuit breakers shall be individually mounted. Branch-mounted main circuit breakers are not acceptable unless specifically indicated on the Drawings. Coordinate top or bottom mounting of main circuit breaker with incoming conduit location(s).

3. Tandem or half-size circuit breakers are not acceptable.

4. Circuit breaker voltage ratings shall meet or exceed the panelboard voltage indicated on the Drawings. The number of poles and trip ratings shall be as indicated on the Drawings. Where a trip rating is not indicated on the Drawings, provide a 20A circuit breaker.

5. Circuit breakers for panelboards rated 240VAC and below shall have an interrupting rating at 240 VAC that matches the panelboard short circuit rating. Circuit breakers for panelboards rated above 240VAC shall have an interrupting rating at 480 VAC that matches the panelboard short circuit rating.

6. Unless indicated otherwise on the Drawings, circuit breakers with smaller than 225-ampere frames shall be the thermal-magnetic type. Thermal and magnetic trip elements may be fixed or adjustable.

7. Where indicated on the Drawings, and for circuit breakers of 225-ampere frames and larger, circuit breakers shall have interchangeable electronic trip units (ETU) and adjustable trip elements and time delays. Provide electronic trip units with the adjustable functions indicated on the Drawings (e.g., Long, Short, Instantaneous, Ground, etc.).

8. Where indicated on the Drawings, or where required by Code, circuit breakers shall be equipped with integrally mounted ground fault circuit interrupters (i.e., GFI/GFCI) complete with "TEST" push button, and shall be of a type which fit standard panelboard spaces for the breaker continuous current rating required. Ground fault circuit interrupter style circuit breakers shall be UL 943 Listed. Circuit

breakers used for lighting circuit switching shall be approved for the purpose and shall be marked "SWD". Where required by Article 440 of the NEC, circuit breakers installed for air conditioning units shall be HACR type.

9. Where indicated on the Drawings, circuit breakers shall be 100% rated.

10. Where indicated on the Drawings, main circuit breakers shall be provided with a shunt trip device to trip the breaker from a remote location by means of a trip coil energized from a separate circuit. A 120 VAC shunt trip shall be capable of operating at 55% or more of rated voltage. All other shunt trips shall be capable of operating at 75% or more of rated voltage.

11. Where indicated on the Drawings, or as required, circuit breakers shall be provided with a padlockable hasp or handle padlock attachment (lock-off device) for padlocking in the “OFF” position as required to meet the NEC requirement for disconnecting means and/or OSHA lock-out/tagout standard. Locking hardware shall remain in place even when the padlock is removed. Where indicated on the Drawings, or as required, branch circuit breakers shall be provided with a similar attachment (lock-on device) for padlocking in the “ON” position for critical circuits (e.g., fire alarm control panel circuits) which must remain energized.

E. Directories

1. Approved directories with noncombustible plastic cover, and with typewritten designations of each branch circuit, shall be furnished and installed in each panelboard (including both new panelboards and existing panelboards modified under this project). The Contractor shall maintain in each panelboard, during the duration of the Contract, a handwritten directory clearly indicating the circuit breakers in service. This directory shall be updated as work progresses, and final, typewritten directories, as specified above, shall be installed at the end of the project. Designations and circuit locations shall conform to the panelboard schedules on the Drawings, except as otherwise authorized by the Engineer.

2.03 SURGE PROTECTIVE DEVICES

A. Surge protective devices (SPD) shall be provided either integral to the panelboard or as a separate unit external to the panelboard enclosure, as indicated on the Drawings. See Section 26 43 13 – Surge Protective Devices for SPD requirements.

B. Integral SPDs shall be installed within the panelboard enclosure in a location that allows the required quantity and rating of branch circuit breakers to be installed. Reducing the quantity of branch circuit breakers to less than that required by the panel schedules is not acceptable.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Panelboards and combination power units shall be furnished and installed as shown on the Drawings and as recommended by the equipment manufacturer, and as required by NECA 407.

B. Panelboards shall be set true and plumb in locations as shown on the Drawings. The top of panelboard enclosure shall not exceed six (6) feet above finished floor elevation.

C. Enclosures shall not be fastened to concrete or masonry surfaces with wooden plugs. Appropriate cadmium plated or galvanized steel bolts shall be used with expansion shields or other metallic type concrete insert for mounting on concrete or solid masonry walls. Cadmium plated or galvanized steel toggle bolts shall be used for mounting on concrete block or other hollow masonry walls. Bolt diameter shall be as required considering the size and weight of the completed panelboard and enclosure to provide adequate structural support.

D. The Contractor shall not use factory furnished knockouts with surface mounted back boxes. The Contractor shall punch or drill required openings during installation and shall equip flush mounted back boxes with manufacturer's standard pattern of knockouts.

E. The Contractor shall install cabinets (and other enclosure products) in plumb with the building construction. Flush mounted enclosures shall be installed so that the trim will rest against the surrounding surface material and around the entire perimeter of the enclosure.

F. Bus loads in all panelboards shall be balanced between phases to within a tolerance of one (1) KVA. Convenience receptacles shall be distributed evenly among all phase buses as much as practical.

G. Prior to final completion of the work, all metal surfaces of the equipment shall be cleaned thoroughly, and all scratches and abrasions shall be retouched with the same lacquer as used for shop finishing coats.

3.02 TESTING

A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 01. The following tests are required:

1. Field Tests

a. Prior to termination of any conductors to the circuit breakers, all bus work and circuit breakers shall be tested from phase to phase and phase to ground with a 1000 VDC megohmmeter for 1 minute in accordance with

NECA 407. Resistance values shall be recorded and shall not be less than 100 megohms.

b. Prior to terminating any wires to the circuit breakers, the resistance of the connection between the bus work and each circuit breaker shall be tested through the use of a low-resistance ohmmeter. Record the resistance values for each circuit breaker.

END OF SECTION

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SECTION 26 27 26
WIRING DEVICES

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish and install all switches, occupancy sensors, and receptacles as shown on the Drawings.

B. All switches and receptacles shall be furnished and installed in outlet boxes. Reference Section 26 05 33.16 – Boxes for Electrical Systems for outlet box requirements.

C. Reference Section 26 05 00 – Basic Electrical Requirements and Section 26 05 19 – Low-Voltage Conductors and Cables.

1.02 CODES AND STANDARDS

A. All equipment shall be Listed by and shall bear the Label of Underwriter's Laboratories, Incorporated (UL).

B. Wiring devices shall be designed, manufactured, and/or Listed to the following standards as applicable:

1. National Fire Protection Association (NFPA):

    a. NFPA 70 – National Electrical Code (NEC).

2. Underwriters Laboratories (UL):

    a. UL 20 – General Use Snap Switches.

    b. UL 498 – Standard for Attachment Plugs and Receptacles.

    c. UL 943 – Ground Fault Circuit Interrupters.

    d. UL 1203 – Standard for Explosion-proof and Dust-ignition-proof Electrical Equipment for use in Hazardous (Classified) Locations.

1.03 SUBMITTALS

A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01 33 00 – Submittal Procedures, the Contractor shall obtain from the equipment manufacturer and submit shop drawings. Each submittal shall be identified by the applicable Specification Section.

1.04 SHOP DRAWINGS

A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.

B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for resubmittal.

C. Shop drawings shall include, but not be limited to:

1. Product data sheets.

1.05 SPARE PARTS

A. The Contractor shall furnish 10% (minimum of 1) spare of each receptacle, switch, and plug furnished and installed for this project.

B. Reference Section 26 05 00 – Basic Electrical Requirements for spare parts delivery and handling requirements.

1.06 IDENTIFICATION

A. Each switch and receptacle shall be identified with the equipment item number, manufacturer's name or trademark, and such other information as the manufacturer may consider necessary, or as specified, for complete identification.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. The equipment covered by these Specifications is intended to be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be designed, constructed, and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.

B. The Contractor shall use the products of a single manufacturer for each type of wiring device.

C. The Contractor shall use the products of a single manufacturer for all device plates. Plate variations are allowed for the following devices:

1. Where the selected plate manufacturer does not manufacture a suitable finish plate.

2. For heavy-duty receptacles rated at more than 30A.

3. Where non-standard plates are required, specified, or shown.

D. The Contractor shall furnish and install all wiring devices and device plates.

E. In non-hazardous areas, provide specification grade devices manufactured by Appleton, Crouse-Hinds, Leviton, Hubbell, Pass & Seymour, or Engineer approved equal.

F. In hazardous areas, provide devices manufactured by Appleton, Cooper Crouse-Hinds, Hubbell-Killark, or Engineer approved equal.

2.02 WIRING DEVICES

A. Wall switches for non-hazardous areas shall be rated for the current required to suit the application, but not less than 20A. Double -pole, three-way, and four-way switches shall be provided where indicated on the Drawings, and as required. Switches shall be rated for 120-277VAC and shall be UL 20 Listed.

B. Convenience receptacles for non-hazardous areas shall be rated for 20A at 125VAC and shall be UL 498 Listed. Receptacles shall be weather -resistant where installed in wet or damp locations.

C. Special purpose receptacles (e.g., welders, lab equipment, etc.) shall be provided with the proper NEMA configuration and ampacity as indicated on the Drawings. The coordinating plug for each special purpose receptacle shall be provided with the equipment which it is serving.

D. Ground fault circuit interrupter receptacles shall be rated for 20A at 125VAC and shall be UL 943 Listed. Receptacles shall be weather -resistant where installed in wet or damp locations.

E. Wall switches for hazardous areas shall be the factory sealed type, UL 1203 Listed for use in the hazardous area. Wall switches shall be rated for 120-277VAC, and shall be rated for the current required to suit the application, but not less than 20A.

F. Receptacles for hazardous areas shall be rated 20A at 120-240VAC. Receptacles shall be UL 1203 listed for use in the hazardous area, utilizing delayed-action construction.

G. Wiring devices shall be approved for use with stranded conductors <u>if stranded conductors are to be used with the device</u>. Reference Section 26 05 19 – Low-Voltage Conductors and Cable for conductor requirements

2.03 DEVICE PLATES

A. Device plates for indoor flush-mounted receptacles and switches shall be made of Type 304 stainless steel, not less than 0.032 of an inch thick, with beveled edges and milled on the rear so as to lie flat against the wall. Devices plates shall be provided with a gasket.

B. Device plates for outdoor installations, indoor wet process areas, and chemical storage/transfer areas shall be Appleton Type FSK-1VS-A, Crouse-Hinds #DS185, or Engineer approved equal for wall switches. Device plates for receptacles shall be “in-use” style, and shall be fully closable when a plug/cord is inserted. “In-use” weatherproof covers shall be rugged, minimum 3 ¼” depth, die-cast aluminum as manufactured by Thomas & Betts "Red Dot," Intermatic International, Inc., or Engineer approved equal.

C. Device plates for indoor dry process and non-process areas with surface mounted boxes shall be Crouse-Hinds DS32 or Engineer approved equal for switches, and Crouse-Hinds DS23 or Engineer approved equal for receptacles.

2.04 PLUGS

A. The Contractor shall furnish suitable plugs with equipment furnished under the respective Specification Section. Plugs shall be black rubber or plastic. For waterproof receptacles, the plugs shall be similar in construction to the receptacles and shall be encased in corrosion resistant yellow housing provided with clamping nuts and stuffing gland cable outlets.

2.05 PROCESS INSTRUMENTS

A. The Contractor shall furnish and install a local disconnect switch at each process instrument (e.g., level transmitter, flow transmitter, analytical instrument, etc.) to disconnect the 120VAC power supply to the instrument. The device shall be a NSSC series manual motor starting switch without overload protection as manufactured by Crouse-Hinds, Appleton equivalent, or Engineer approved equal. For hazardous locations, the device shall be UL 1203 Listed.

2.06

PART 3 – EXECUTION

3.01 INSTALLATION

A. Where more than one (1) switch occurs at one (1) location, gang plates shall be used.

B. All device plates shall be set true and plumb and shall fit tightly against the finished wall surfaces and outlet boxes.

C. Wiring device box (outlet box) mounting heights shall be as specified in Section 26 05 33.16 – Boxes for Electrical Systems.

D. When indicated height would place any of the equipment at an unsuitable location such as at a molding or break in wall finish, the Contractor shall bring it to the attention of the Engineer for a decision.

E. Receptacles installed in toilet, locker, and bathrooms, and within 6 feet of a sink, shall be of ground fault circuit interrupter (GFCI) type. GFCI receptacles shall also be furnished and installed in additional locations where indicated on the Drawings, and as required by the NEC.

F. All receptacles shall have a self-adhesive label installed on the top at the respective device plate that indicates which panel and which circuit number the receptacle is supplied from. Labels shall have a white background and black lettering in 14-point font.

G. The turn-off time delay for each occupancy sensor shall initially be set to 10 minutes. Contractor shall be responsible for the proper commissioning and testing of each occupancy sensor to ensure that it operates to the Owner and Engineer's satisfaction.

3.02 CIRCUITING

A. Convenience receptacles shall be grouped on circuits separate from the lighting circuits. A maximum of eight (8) convenience receptacles are permitted per 20A, 120V circuit, unless otherwise indicated on the Drawings.

END OF SECTION

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SECTION 26 29 13.13

LOW-VOLTAGE ENCLOSED MOTOR CONTROLLERS – FULL VOLTAGE

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish, install, test, and place in satisfactory operation separately mounted, full voltage individual motor controllers as specified herein and indicated on the Drawings. Individual motor controllers specified in this Section include magnetic motor starters and manual motor starters.

B. Reference the following Specification Sections:

1. Section 26 05 00 – Basic Electrical Requirements

2. Section 26 05 19 – Low Voltage Conductors and Cables

3. Section 26 05 53 – Identification for Electrical Systems

4. Section 26 09 16 – Electric Controls and Relays

1.02 CODES AND STANDARDS

A. All equipment shall be Listed by and shall bear the Label of Underwriter's Laboratories, Incorporated (UL).

B. Enclosed motor controllers shall be designed, manufactured, and/or Listed to the following standards as applicable:

1. National Electrical Manufacturers Association (NEMA):

a. NEMA 250 – Enclosures for Electrical Equipment.

b. NEMA ICS 2 – Controllers, Contactors and Overload Relays Rated 600 Volts.

2. National Fire Protection Association (NFPA):

a. NFPA 70 – National Electrical Code (NEC).

3. Underwriters Laboratories (UL):

a. UL 489 – Molded Case Circuit Breakers, Molded Case Switches, and Circuit Breakers.

b. UL 508A – Standard for Industrial Control Panels.

c.

1.03 SUBMITTALS

A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01 33 00 – Submittal Procedures, the Contractor shall obtain from the equipment manufacturer and submit the following:

1. Shop Drawings.

2. Spare Parts.

3. Reports of Certified Shop and Field Tests.

4. Operation and Maintenance Manuals.

B. Each submittal shall be identified by the applicable Specification Section.

1.04 SHOP DRAWINGS

A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.

B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for resubmittal.

C. Shop drawings shall include but not be limited to:

1. Product data sheets.

2. Complete layout and installation drawings with clearly marked dimensions for each type/size/rating of individual motor controller.

3. Custom wiring diagrams for each individual motor controller. Standard wiring diagrams that are not custom created by the manufacturer for the individual motor controllers for this project are not acceptable. One wiring diagram which is typical for an equipment group (e.g. reuse water pump) is not acceptable. Each wiring diagram shall include wire identification and terminal numbers. Indicate all devices, regardless of their physical location, on the diagrams. Identify on each respective wiring diagram specific equipment names and equipment numbers consistent with those indicated on the Drawings.

4. Bill of material list for each individual motor controller.

5. Nameplate schedule for each individual motor controller.

6. Manufacturer’s installation instructions.

7. Table listing all motor loads connected to the motor controller. Table shall include the full load amps of the APPROVED motors. Final approval of motor controller shop drawings cannot be given until all motor loads associated with each motor controller have been reviewed, approved, and shown in this table.

8. Time-current curves for each type and size protective device if requested by the Engineer.

D. The shop drawing information shall be complete and organized in such a way that the Engineer can determine if the requirements of these Specifications are being met. Copies of technical bulletins, technical data sheets from "soft-cover" catalogs, and similar information which is "highlighted" or somehow identifies the specific equipment items that the Contractor intends to provide are acceptable and shall be submitted.

E. Prior to completion and final acceptance of the project, the Contractor shall furnish and install "as-built" wiring diagrams for individual motor controller. These final drawings shall be plastic laminated and securely placed inside each individual motor controller unit door and included in the O&M manuals.

1.05 OPERATION AND MAINTENANCE MANUALS

A. The Contractor shall submit operation and maintenance manuals in accordance with the procedures and requirements set forth in the General Conditions and Division 01.

1.06 SPARE PARTS

A. All spare parts as recommended by the equipment manufacturer shall be furnished to the Owner by the Contractor. The Contractor shall furnish the following additional spare parts:

1. Two (2) spare fuses for each size and type if used.

B. Reference Section 26 05 00 – Basic Electrical Requirements for spare parts delivery and handling requirements.

1.07 IDENTIFICATION

A. Each equipment item shall be identified with a nameplate. The nameplate shall be engraved with the equipment name and/or number with which it is associated. Equipment identification shall be in accordance with Section 26 05 53 – Identification for Electrical Systems.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. The equipment covered by this Specification is intended to be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be designed, constructed, and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.

2.02 INDIVIDUAL MAGNETIC MOTOR STARTERS

A. **The Contractor** is fully responsible for the review of the full Contract Documents to determine specified motor speed, horsepower and full load ampere requirements for each motor-driven load.

B. Individual magnetic motor starters shall be combination type complete with motor circuit protectors (MCPs). Starters shall be rated 480 VAC, 3-pole, sized for the intended load unless otherwise indicated. In no case shall a starter smaller than a NEMA Size 1 be used. Each starter shall be furnished with a minimum of two (2) spare auxiliary contacts.

C. Motor branch circuits shall be protected by a motor circuit protector (MCP). MCP sizes shall be selected by the manufacturer based on the motor nameplate information gathered and listed in the table required herein. MCP shall have an adjustment range that allows for between 800% and 1200% of motor nameplate FLA.

D. Starters shall be provided with all coils and controls for 120 VAC operation, unless otherwise indicated on the Drawings.

E. The motor controller manufacturer is advised to review the total Contract Documents for additional requirements for space heaters, power factor correction capacitors, and similar equipment which may not be specified in this Division or shown on the Drawings. Control power transformers shall be fused on both the primary and secondary sides. The minimum control power transformer VA requirements are as shown below. Control power transformers shall be sized as required for the connected loads, plus 25% spare capacity.

1. Size 1-150 VA
2. Size 2-150 VA
3. Size 3-200 VA
4. Size 4-300 VA
5. Size 5-500 VA

F. Each starter shall be supplied with a manual reset overload relay. Manual reset shall be accomplished by a door mounted overload reset pushbutton. The relays shall be solid state type, with at least one isolated normally open and one isolated normally closed auxiliary contact that operates when a trip condition has occurred. Relays shall be self-powered, have a visible trip indicator, have a trip test function, and have selectable Class 10 or 20 operation. Overload relays shall be set for Class 10 operation unless otherwise directed by the Engineer. Overload relay shall have phase loss protection built in to trip the unit and protect the motor against single phasing. The Contractor shall provide the overload relay model with the correct current range for each application. Overload relay shall have adjustable current range dial. Eutectic alloy and bi-metallic type overload relays are not acceptable.

G. Enclosures

1. In non-hazardous locations, motor starters shall be furnished with the following enclosure type and material of construction, dependent upon the designation of the area in which they are to be installed. Area designations are indicated on the Drawings.

Area Designation	**Enclosure Type and Material**
Indoor Wet Process Area	NEMA 4X, Type 316 Stainless Steel
Indoor Dry Process Area	NEMA 12, Type 316 Stainless Steel
Indoor Dry Non-Process Area	NEMA 1, Type 316 Stainless Steel
Indoor Type 1 Chemical Storage/Transfer Area	NEMA 4X, Fiberglass
Indoor Type 2 Chemical Storage/Transfer Area	NEMA 4X, Type 316 Stainless Steel
All Outdoor Areas	NEMA 4X, Type 316 Stainless Steel

2. In hazardous locations, motor starters shall be furnished with the following enclosure type and material of construction, dependent upon the classification of the area in which they are to be installed. Area classifications are indicated on the Drawings.

Area Classification	**Enclosure Type and Material**
Class I, Division 1, Group D	NEMA 7, Die Cast Aluminum
Class I, Division 2, Group D	NEMA 7, Die Cast Aluminum
Class II, Division 1, Group F	NEMA 9, Die Cast Aluminum
Class II, Division 2, Group F	NEMA 9, Die Cast Aluminum

3. Each motor controller enclosure in non-hazardous areas shall be supplied with an industrial, heavy-duty flange-mount handle mechanism for the operation of the motor controller disconnecting means as follows:

    a. The mechanism shall be engaged with the disconnect device at all times as an integral part of the unit regardless of the unit door position.

    b. The operator handle shall have an up-down motion with the down position as off. The ON-OFF condition of the disconnecting means shall be permanently marked on the handle operator.

    c. It shall be possible to lock the handle in the "OFF" position with up to three (3) 3/8-inch diameter shackle padlocks and in the "ON" position with one (1) 3/8-inch diameter shackle padlock.

    d. The operator handle shall be mechanically interlocked such that the disconnecting means cannot be closed with the enclosure door open, nor can the enclosure door be opened when the disconnecting means is closed. A defeater mechanism shall be provided so that qualified personnel can bypass these interlocks for maintenance and testing purposes. The defeater mechanism shall allow the enclosure door to be opened without interrupting the operation of the motor controller.

4. Each motor controller enclosure in hazardous areas shall be supplied with an industrial, heavy-duty door-mounted handle mechanism for the operation of the motor controller disconnecting means as follows:

    a. The operator handle shall have an up-down motion with the down position as off. The ON-OFF condition of the disconnecting means shall be permanently marked on the handle operator or door.

    b. It shall be possible to lock the handle in the "OFF" position with up to one (1) 3/8-inch diameter shackle padlock and in the "ON" position with one (1) 3/8-inch diameter shackle padlock.

    c. The operator handle shall be mechanically interlocked such that the disconnecting means cannot be closed with the enclosure door open, nor can the enclosure door be opened when the disconnecting means is closed. No defeater mechanisms shall be permitted.

H. Control Devices

1. Furnish and install control devices as required and/or shown on the Drawings. The following control devices shall be provided as specified in Section 26 09 16 – Electric Controls and Relays:

a. Pilot devices (switches, indicating lights, etc.)

b. Relays and timers

c. Control terminal blocks

I. All control wiring shall be No. 14 AWG (minimum) labeled at each end in accordance with the wiring numbers shown on the accepted shop drawings. Power wiring shall be sized to suit the maximum horsepower rating of unit; No. 12 AWG (minimum). Wiring shall be type MTW rated for 105ºC. Wire color coding shall be as specified in Section 26 05 19 – Low Voltage Conductors and Cables.

J. Each motor starter coil shall be equipped with a surge-suppression device, where applicable, for protection of solid-state equipment (e.g., programmable logic controller) wired as part of the control circuit.

K. Individual magnetic motor starters shall be as manufactured by Eaton using NEMA rated Freedom Series starters and contactors, GE by ABB equivalent, the Square D Company equivalent, Rockwell Automation (Allen-Bradley) equivalent, or Siemens Energy & Automation, Inc. equivalent.

2.03 INDIVIDUAL MANUAL MOTOR STARTERS

A. Individual manual motor starters in enclosures as specified above shall be furnished and installed for outdoor and indoor exposed work. Furnish and install manual motor starters in outlet boxes with flush wall plates as required for concealed work.

B. Furnish and install manual motor starters with pilot lights and overload heater elements of correct rating based on motor nameplate data.

C. Manual motor starters shall be equipped with either a push button or toggle operator with reset device or mechanism accessible without opening the enclosure.

D. Individual manual motor starters for motors one (1) horsepower and less shall be Eaton Type MS, GE by ABB equivalent, the Square D Company equivalent, Rockwell Automation (Allen-Bradley) equivalent, or Siemens Energy & Automation, Inc. equivalent.

E. Individual manual motor starters for integral horsepower motors shall be Eaton Type B100 or B101, GE by ABB equivalents, the Square D Company equivalents, Rockwell Automation (Allen-Bradley) equivalent, or Siemens Energy and Automation, Inc. equivalents.

PART 3 – EXECUTION

3.01 INSTALLATION

A. All individual motor starters shall be installed as indicated on the Drawings and as recommended by the equipment manufacturer.

B. Individual motor starters shall be provided in the enclosure type and material of construction required for the area in which it is installed. Reference the requirements in Part 2 herein, and the area designations indicated on the Drawings.

3.02 TESTING

A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 01. The following tests are required:

1. Witnessed Shop Tests

    a. None required.

2. Field Tests

    a. Field testing shall be done in accordance with the requirements specified in the General Conditions, Division 01, and NETA Acceptance Testing Specifications, latest edition.

3.03 FIELD ADJUSTMENTS

A. The settings of the motor circuit protectors and overload relays shall be set based on the motor nameplate data of the motors installed.

END OF SECTION

SECTION 26 43 13
SURGE PROTECTIVE DEVICES

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish, install, and place in satisfactory operation the surge protective devices (SPD) as specified herein and indicated on the Drawings.

B. Reference the following Specification Sections:

1. Section 26 05 19 – Low-Voltage Conductors and Cables

2. Section 26 05 53 – Identification for Electrical Systems.

1.02 CODES AND STANDARDS

A. All equipment shall be Listed by and shall bear the Label of Underwriter's Laboratories, Incorporated (UL).

B. The equipment shall be designed, manufactured, and/or Listed to the following standards as applicable:

1. American National Standards Institute (ANSI)/Institute of Electrical & Electronic Engineers (IEEE):

a. C62.41.1 – IEEE Guide on the Surge Environment in Low-Voltage (1000 V and less) AC Power Circuits.

b. C62.41.2 – IEEE Recommended Practice on Characterization of Surges in Low -Voltage (1000 V and less) AC Power Circuits.

c. C62.45 – IEEE Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000 V and less) AC Power Circuits.

d. C62.62 – IEEE Standard Test Specifications for Surge -Protective Devices (SPDs) for Use on the Load Side of the Service Equipment in Low Voltage (1000 V and less) AC Power Circuits.

2. National Fire Protection Association (NFPA):

a. NFPA 70 – National Electrical Code (NEC).

3. Underwriters Laboratories (UL):

a. UL 1283 – Electromagnetic Interference Filters.

b. UL 1449 – Surge Protective Devices.

1.03 SUBMITTALS

A. In accordance with the procedures and requirements set forth in General Conditions and Section 01 33 00 – Submittal Procedures, the Contractor shall obtain from the equipment manufacturer and submit the following:

1. Shop Drawings

2. Operation and Maintenance Manuals

3. Spare Parts List

1.04 SHOP DRAWINGS

A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.

B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for re-submittal.

C. Drawings submitted by the manufacturer shall be complete and documented to provide the Owner with operations and maintenance capabilities.

D. Shop drawings for each SPD shall include but not be limited to:

1. A Compliance, Deviations, and Exceptions (CD&E) letter. If the shop drawings are submitted without this CD&E letter, the submittal will be rejected. The letter shall include all comments, deviations and exceptions taken to the Drawings and Specifications by the Contractor AND Equipment Manufacturer/Supplier. This letter shall include a copy of this Specification Section. In the left margin beside each paragraph/item, a letter "C", "D", or "E" shall be typed or written in. The letter "C" shall be for full compliance with the requirement. The letter "D" shall be for a deviation from the requirement. The letter "E" shall be for taking exception to a requirement. Any requirements with the letter "D" or "E" beside them shall be provided with a full typewritten explanation of the deviation/exception. Handwritten explanation of the deviations/exceptions is not acceptable. The CD&E letter shall also address deviations, and exceptions taken to each Drawing related to this Specification Section.

2. Product Data Sheets.

3. Detailed drawings showing weights and dimensions.

4. Wiring diagrams showing field connections.

5. Proof that all products provided under this Section are UL Listed and Labeled by Underwriters Laboratories to UL1449, latest Edition. This proof shall be a copy of the data listed under the UL File Number for the manufacturer, which may be obtained from the UL Online Certification Directory. No other means of proving compliance (such as manufacturer data sheets, marketing material, etc.) will be considered acceptable.

6. Proof of Short Circuit Current Ratings (SCCR), Voltage Protection Ratings (VPRs) for all modes, Maximum Continuous Operating Voltage rating (MCOV), Nominal Discharge Current (In), and device listing Type shall be submitted using the same means as described in the paragraph above.

7. Proof that all products provided under this Section are UL Listed and Labeled by Underwriters Laboratories to UL 1283, latest Edition. This proof shall be a copy of the data listed under the UL File Number for the manufacturer, which may be obtained from the UL Online Certification Directory. No other means of proving compliance (such as manufacturer data sheets, marketing material, etc.) will be considered acceptable.

8. Manufacturer’s Warranty Information

E. The shop drawing information shall be complete and organized in such a way that the Engineer can determine if the requirements of these Specifications are being met. Copies of technical bulletins, technical data sheets from "Soft Cover" catalogs, and similar information which is "highlighted" or somehow identifies the specific equipment items the Contractor intends to provide are to provide are acceptable and shall be submitted.

1.05 OPERATION AND MAINTENANCE MANUALS

A. The Contractor shall submit operation and maintenance manuals in accordance with the procedures and requirements set forth in the General Conditions and Division 01.

1.06 SPARE PARTS

A. All spare parts as recommended by the equipment manufacturer shall be furnished by the Contractor to the Owner.

B. The Contractor shall furnish one (1) spare field replacement module of each type and rating provided under this Contract.

C. Reference Section 26 05 00 – Basic Electrical Requirements for spare parts delivery and handling requirements.

1.07 IDENTIFICATION

A. Each SPD shall be identified by the circuit number and equipment name as indicated on the Drawings. A nameplate shall be securely affixed in a conspicuous place on each SPD. Nameplates shall be as specified in Section 26 05 53 – Identification for Electrical Systems.

1.08 WARRANTY

A. All SPDs, associated hardware, and supporting components shall be warranted to be free from defects in materials and workmanship, under normal use and in accordance with the instructions provided, for a period of five (5) years after acceptance of the equipment by the Owner.

B. Any component or subassembly contained within the surge protection system that shows evidence of failure or incorrect operation during the warranty period, shall be replaced by the manufacturer at no additional cost to the Owner.

PART 2 – PRODUCTS

2.01 GENERAL

A. The SPD units shall be UL 1449 Listed and shall bear the UL mark. Units that are “manufactured in accordance with” UL 1449 or tested by other testing agencies “in accordance with” UL 1449 are not acceptable and will be rejected.

B. Type II SPD units shall be UL 1283 Listed and shall bear the UL mark. Units that are “manufactured in accordance with” UL 1283 or tested by other testing agencies “in accordance with” UL 1283 are not acceptable and will be rejected. Further, SPD units using UL 1283 capacitors but not tested to UL 1283 will be rejected.

2.02 PRODUCTS

A. Type I surge protective devices (SPD) shall be furnished and installed when shown without upstream overcurrent protection on the Drawings. Type II SPDs shall be provided in all other locations. Type II SPDs shall not require the use of a specific upstream overcurrent device. SPDs shall be provided in the location and quantity as shown on the Drawings.

B. Each SPD shall be rated for the voltage and configuration of the equipment to which it is connected.

C. Each Type II SPD shall have UL 1283 EMI/RFI filtering with minimum attenuation of -50dB at 100kHz.

D. The short circuit current rating of each SPD shall match or exceed the rating of the equipment to which it is connected. The Contractor shall reference the Drawings for short circuit current rating of each piece of equipment.

E. Each SPD system shall provide surge protection in all possible modes. Surge protection shall be as follows:

System Configuration	Modes of Protection	Number of Modes
3-Phase Wye	L-N, L-G, N-G	7
3-Phase Delta	L-L, L-G	6
3-Phase Impedance Grounded	L-L, L-G	6
Single-Phase	L-N, L-G, N-G	3

F. Each SPD shall have a Maximum Continuous Operating Voltage (MCOV) of at least 115% of the nominal voltage of the equipment to which it is connected.

G. The Nominal Discharge Current (In) of each SPD shall be 20kA. Peak surge current ratings shall not be used as a basis for applying the SPD to the system.

H. The Voltage Protection Rating (VPR) of each SPD shall not exceed the following:

System Voltage	L-N	L-G	L-L	N-G
208Y/120	800V	800V	1200V	800V
480Y/277	1200V	1200V	1800V	1200V
480 DELTA	N/A	1800V	1800V	N/A
240 DELTA	N/A	1200V	1200V	N/A
120/240	800V	800V	1200V	800V

I. SPDs which are indicated to be installed externally mounted from the equipment that they protect shall be provided within a separate enclosure. The enclosure shall match or exceed the NEMA rating of the enclosure for the equipment that it is serving (e.g., NEMA1, NEMA 12, NEMA 4X, etc.).

J. Each SPD shall be provided with the following accessories:

1. Each individual module shall feature an LED indicating the individual module has all surge protection devices active. If any single component is taken off-line, the LED shall turn off and another LED shall illuminate, providing individual module as well as total system status indication.

2. Surge counter and audible alarm with reset/silence switch.

3. One set of Form C (SPDT) dry contacts rated for at least 5A at 120VAC.

K. SPDs which are indicated to be installed integral to (within) the equipment that they protect shall be manufactured by the same manufacturer as the equipment. SPDs which are indicated to be installed externally/separately mounted from the equipment that they serve shall be manufactured by Eaton, ASCO/Emerson Network Power, Current Technologies, GE by ABB, or Square D.

PART 3 – EXECUTION

3.01 INSTALLATION

A. The SPD units shall be furnished and installed as shown on the Drawings and in accordance with the manufacturer's installation instructions.

B. SPDs which are indicated to be integral with the equipment that they protect shall be installed within the enclosure for that equipment.

C. Externally mounted SPDs shall be installed as follows:

1. The SPD units shall be mounted such that the conductor lengths are as short as possible, but no greater than 36 inches. Any installation resulting in a conductor length of greater than 36 inches shall be reviewed with the Engineer as a special type of cable may need to be installed. For equipment such as panelboards, the Contractor shall relocate the circuit breaker that is to be connected to the SPD as needed to achieve the shortest conductor length possible.

2. The Contractor shall use a close nipple to enclose the conductors between the SPD and the equipment served. However, if due to field conditions a 90 degree conduit bend is required to connect the SPD to the equipment that it serves, the bend shall have a minimum radius of 36 inches to eliminate any potential for sharp bends in the conductors.

3. Conductors between the equipment served and the SPD shall be 600V power wire and cable as specified in Section 26 05 19 – Low-Voltage Conductors and Cables. The individual conductors shall be gently twisted and sized as indicated on the Drawings.

D. Prior to energizing, the following shall be performed for each SPD:

1. Verify that the SPD unit voltage and configuration is suitable for the system to which it is connected.

2. Verify that any neutral-to-ground bonding jumpers are installed as required.

3.02 TESTING

A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 01. The following tests are required:

1. Shop Tests

a. Standard factory tests shall be performed on the equipment under this Section. All tests shall be in accordance with the latest version of NEMA, ANSI, and UL standards.

b. All surge protective devices, subassemblies, and components shall be 100% tested and certified by the manufacturer to meet their published performance parameters.

2. Field Tests

a. None required.

END OF SECTION

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SECTION 26 50 00

LIGHTING

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish and install all lighting fixtures, labor, and material, in accordance with the preceding Specifications, the requirements of this Section, and as shown on the Drawings.

B. Reference the following Specification Sections:

1. Section 26 05 00 – Basic Electrical Requirements

2. Section 26 05 26 – Grounding and Bonding for Electrical Systems

1.02 CODES AND STANDARDS

A. All equipment shall be Listed by and shall bear the Label of Underwriter's Laboratories, Incorporated (UL).

B. The equipment shall be designed, manufactured, and/or Listed to the following standards as applicable.

1. Institute of Electrical and Electronic Engineers (IEEE)

    a. IEEE C62.41.3 – Guide for Surge Voltages in Low-Voltage AC Power Circuits

2. Illuminating Engineering Society (IES)

3. National Fire Protection Association (NFPA)

    a. NFPA 70 – National Electric Code (NEC).

4. Underwriters Laboratories (UL)

    a. UL 924 – Emergency Lighting and Power Equipment

    b. UL 844 – Luminaires for Use in Hazardous (Classified) Locations

    c. UL 916 – Standard for Energy Management Equipment

    d. UL 1012 – Standard for Safety Power Units Other Than Class 2

e. UL 1598 – Luminaires

1.03 SUBMITTALS

A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01 33 00 – Submittal Procedures, the Contractor shall obtain from the equipment manufacturer and submit the following:

1. Shop Drawings

2. Operation and Maintenance Manuals

3. Spare Parts Lists

B. Each submittal shall be identified by the applicable Specification Section.

1.04 SHOP DRAWINGS

A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.

B. Partial, incomplete, or illegible submittals will be returned to the Contractor for resubmittal without review.

C. Shop drawings shall include but not be limited to:

1. Product data sheets.

2. Catalog cuts for each fixture type showing performance and construction details of standard fixtures, and complete working drawings showing all proposed construction details of special or modified standard fixtures.

3. Photometric curves.

4. LED data including efficiency (Efficacy lumens/watt) information.

5. LED Driver information

6. Catalog data including applicable coefficients of utilization tables, isolux chart of illumination on a horizontal plane, beam efficiency, horizontal and vertical beam spread, and beam lumens.

7. Manufacturer’s warranty information.

8. Manufacturer's connection/wiring diagram for each astronomical time switch system used on the project

9. System (entire fixture assembly) efficiency data.

10. Site lighting poles and foundations calculations where indicated on plans.

D. Shop drawings shall be submitted to the Engineer for review and acceptance for all fixtures before fixtures and poles are manufactured. Substitutions will be permitted only if acceptable to the Engineer.

E. Manufacturer's model/series and description in the fixture schedule on the Contract Documents establishes a level of quality, style, finish, etc. The use of a model/series describing the various types of fixtures shall be used as a guide only and does not exclude all the required accessories or hardware that may be required for a complete installation.

1.05 OPERATION AND MAINTENANCE MANUALS

A. The Contractor shall submit Operation and Maintenance Manuals in accordance with the procedures and requirements set forth in the General Conditions and Division 01.

1.06 SPARE PARTS

A. All spare parts as recommended by the equipment manufacturer shall be furnished to the Owner by the Contractor. The following additional spare parts shall be furnished:

1. A minimum of one (1) LED driver for every ten (10) drivers (of the same type) installed.

A. Reference Section 26 05 00 – Basic Electrical Requirements for spare parts delivery and handling requirements.

1.07 LIGHTING CONTROLS

A. The lighting systems shall be controlled as specified herein and indicated on the Drawings.

1.08 WARRANTY

A. The manufacturer's warranty shall in no event be for a period of less than five (5) years from date of delivery of fixtures to the project site and shall include repair labor, travel expense necessary for repairs at the jobsite, shipping costs, expendables used during the course of repair, or complete replacement of the failed lighting unit.

B. Warranty shall be provided for the entire fixture and shall include all parts and accessories. Submittals received without written warranties as specified shall be rejected in their entirety.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. The equipment covered by this Specification is intended to be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be designed, constructed, and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.

B. The fixture schedule indicates the basis-of-design manufacturer(s) for each fixture type. The Contractor shall submit photometric calculations for each space and/or area where the Contractor wishes to use an equivalent fixture in accordance with Section 26 05 00 – Basic Electrical Requirements. Fixtures will be approved or denied as equivalent on a per-fixture and/or per-space/area basis.

2.02 FIXTURES

A. All lighting fixtures shall be furnished complete with all fittings and hardware necessary for a complete installation. Lighting fixtures shall have all accessories, characteristics, and functionality as specified.

B. Fixture leads shall be as required by NEC. Fixtures shall be grounded by the equipment grounding conductor in the conduit.

C. All glassware shall be high quality, homogeneous in texture, uniform in quality, free from defects, of uniform thickness throughout, and properly annealed. Edges shall be well rounded and free from chips or rough edges.

D. Emergency and exit fixtures shall be UL 924 Listed and have a minimum 90 minutes battery back-up.

E. Fixtures for use in hazardous locations shall be UL 844 Listed.

F. Fixtures specified to be damp or wet locations rated shall be UL 1598 Listed.

G. Fixtures shall be as specified in the fixture schedule on the Drawings

2.03 LED DRIVERS

A. Drivers shall have a voltage range of 347-480V or 120-277 (as required) +/- 10% at a frequency 60Hz.

B. All drivers shall be designed to a power factor >90% with a total harmonic distortion THD <20% at full load.

C. Case temperature shall be rated for -40°C through +80°C.

D. Drivers shall have overheat protection, self-limited short circuit protection and overload protected.

E. Drivers shall be furnished with a fused primary.

F. Drivers shall have an output current ripple <30%

G. Drivers shall be manufactured by Philips, Advance, Universal or equal.

H. Drivers shall be UL Listed for damp location, UL1012, ROHS.

I. Drivers shall meet FCC 47 Sub Part 15.

J. All drivers shall be provided with ANSI/IEEE C62.41 Category C (10kV/5kA) surge protection.

2.04 LEDS

A. Luminaires provided with LED technology shall utilize high brightness LEDs with a group binning code of P and/or Q.

B. Color Temperature: as specified in fixture schedule.

C. Junction point shall be designed and manufactured to allow adequate heat dissipation.

D. LEDs shall be rated for 50,000 hours of life, minimum (based on IESNA L70).

2.05 POLES AND FOUNDATIONS

A. Poles shall be designed to withstand calculated wind force based on wind velocity in accordance with the provisions of the Building Code for the State or Commonwealth in which the project is located.

B. Pole mounted fixtures shall be mounted on poles as designated in the fixture schedule or as indicated on the Drawings. Poles shall have adequate handholes. Furnish and install weatherproof receptacles where indicated. All anchor bolts and nuts shall be hot-dipped galvanized steel.

C. The Contractor shall furnish and install a concrete foundation for freestanding pole mounted fixtures as indicated on the Drawings and as required (e.g., site/roadway lighting). The Contractor shall furnish and install structural anchorage/attachment,

including mounting brackets where applicable, for pole mounted fixtures that are attached to a structure (e.g., clarifiers, aeration basins, etc.).

1. Foundation shall be designed and approved by a Professional Structural Engineer (PE) currently licensed in the State or Commonwealth in which the project is located. The wind design shall be in accordance with ASCE 7 and the Building Code for the State or Commonwealth in which the project is located. Submit signed and sealed calculations for review.

2.06 LIGHTING CONTROLS

AREA DESIGNATION	ENCLOSURE TYPE AND MATERIAL
Indoor Wet Process Area	NEMA 4X, Type 316 Stainless Steel
Indoor Dry Process Area	NEMA 12, Painted Steel
Indoor Dry Non-process Area or Climate Controlled	NEMA 1, Painted Steel
Indoor Type 1 Chemical Storage/Transfer Area	NEMA 4X, Fiberglass
Indoor Type 2 Chemical Storage/Transfer Area	NEMA 4X, Type 316 Stainless Steel
All Outdoor Areas	NEMA 4X, Type 316 Stainless Steel

A. Astronomical Time Switch System

1. Furnish and install astronomical time switch system(s) to control lighting as indicated on the Drawings. System shall be Model ET90000 as manufactured by Intermatic, or Engineer approved equal.

2. Integral programmable electronic astronomic controller shall be 365/7-day type, capable of permitting 48 ON and 48 OFF events, minimum. Controllers shall include selectable astronomic (dusk/dawn) settings for each day and each circuit to allow load switching at sunset and/or sunrise without a photo control device. Controller shall allow designation of the geographic location of the unit and whether the location participates in daylight savings time. Controllers shall operate on a 120 VAC, 60 Hz control power supply. The electronic controller shall be UL 916 Listed.

3. A minimum of four (4) SPST load switching contacts shall be provided, with the capacity to expand to up to 16 contacts. Reference Drawings to determine where more than the minimum number of load switching contacts may be required. Load switching contacts shall be rated for 20A (minimum) for LED type lighting loads and be suitable for 120VAC through 277VAC lighting loads. A USB port and

Ethernet communication port, both accessible from outside the enclosure, shall be provided. Enclosure shall be NEMA 3R painted steel for all non-hazardous locations. Astronomical time switch systems shall not be installed in hazardous locations or Indoor Type 1 Chemical Storage/Transfer Areas.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Lighting fixtures shall be located symmetrically with building lines as shown on the Drawings. The Contractor shall furnish and install the lighting fixtures to allow "convenient" access for maintenance. The Contractor shall install fixtures at mounting heights indicated on the Drawings or as instructed by the Engineer. In areas with exposed ducts and/or piping, installation of lighting fixtures shall be adapted to field conditions as determined by the Engineer. Where fixtures are shown in locations on the Drawings where maintenance would be difficult, the Contractor shall notify the Engineer for direction.

B. The Contractor shall provide and install all inserts, conduit, structural supports as required, mounting, poles, wiring, and any other items required for a complete system. Contractor shall properly adjust and test, to the satisfaction of the Engineer, the entire lighting system. The Contractor shall provide pigtails and flexible conduit connected to an outlet box where necessary or required resulting in a neat and complete installation.

C. The Contractor shall protect all fixtures at all times from damage, dirt, dust, and the like. Upon completion of work, and after the building area is broom clean, all fixtures shall be made clean and free of dust and all other foreign matter both on visible surfaces, and on surfaces that affect the lighting performance of the fixture including diffusers, lenses, louvers, reflectors, etc.

D. The Contractor shall furnish and install all pendant trapezes and pendant stem hangers with durable swivel or equivalent trapeze hanger permitting normal fixture motion and self-alignment. Fixture pendants shall be Appleton Type UNJ ball type flexible hanger at the fixture and supports from an Appleton JBLX junction box with JBLX hub cover, or equal. Pendant lengths shall be adequate and adjusted to provide uniformity of installation heights above the reference datum. Stems shall be one-piece, with matching canopies and fittings.

E. All wiring/cables associated with lighting equipment shall be installed in conduits or other raceways as specified. Installing wiring/cables exposed is not acceptable, unless specifically shown otherwise on the Drawings.

F. The Contractor shall furnish and install recessed fixtures with a separate junction box concealed and located as to be accessible when fixture is removed.

G. The Contractor shall furnish and install all boxes for lighting fixtures such that the box is not the sole support of the fixture. The boxes shall be offset to allow maintenance such that access to wiring within the box can be attained without having to consider supporting (holding) the fixture.

H. All lighting fixtures, when installed, shall be set true and be free of light leaks, warps, dents, and other irregularities. All hangers, cables, supports, channels, and brackets of all kinds for safely erecting this equipment in place, shall be furnished and erected in place by the Contractor.

I. The Contractor shall support each fixture securely. The Contractor shall not secure fixtures to the work of other trades, unless specified or noted otherwise, and shall not support fixtures from plaster. The Contractor shall furnish and install all members and supports as required to fasten and suspend fixtures from the structure.

J. In all mechanical equipment areas, the Contractor shall install lighting fixtures after all piping and equipment therein has been installed. Exact locations for such fixtures may be determined by the Engineer on the site during the course of the work.

K. All fixtures that require physical adjustment shall be so adjusted in accordance with the directions of the Engineer. The Contractor shall also adjust angular direction of fixtures as directed.

L. . All optical control surfaces such as lenses and reflectors shall be safely and securely attached to fixtures and shall be easily and quickly removed and replaced for cleaning without the use of special tools.

M. Lighting contactors shall be provided in the enclosure type and material of construction required for the area in which it is installed. Reference the requirements in Part 2 herein, and the area designations indicated on the Drawings.

N. The Contractor shall commission astronomical time switch systems with input from the Engineer and Owner about on/off scheduling. The commissioning shall also include setup of the device’s geographic location and daylight savings time features.

3.02 TESTING

A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 01. The following tests are required:

1. Certified Shop Tests

    a. The lighting fixtures shall be given routine factory tests in accordance with the requirement of ANSI, NEMA and Underwriters Laboratories standards.

2. Field Tests

a. Field testing shall be done in accordance with the requirements specified in the General Conditions, Division 01, and NETA Acceptance Testing Specifications, latest edition.

END OF SECTION

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DIVISION 31 – EARTHWORK

SECTION 31 12 00
SITE PREPARATION

PART 1 – GENERAL

1.01 DEFINITIONS

A. Interfering or Objectionable Material: Trash, rubbish, junk; vegetation, and other organic matter; whether alive, dead, or decaying.

B. Clearing: Removal of interfering or objectionable material lying on or protruding above ground surface.

C. Grubbing: Removal of vegetation and other organic matter including stumps, buried logs, and roots greater than 2 inches caliper to a depth of 12 inches below subgrade.

D. Scalping: Removal of sod without removing more than upper 3 inches of topsoil.

E. Stripping: Removal of topsoil remaining after applicable scalping is completed.

F. Project Limits: Areas, as specified, within which Work is to be performed.

1.02 QUALITY ASSURANCE

A. Obtain Engineer's approval of staked clearing, grubbing, and stripping limits, prior to commencing clearing, grubbing, and stripping.

1.03 SCHEDULING AND SEQUENCING

A. Prepare site only after adequate erosion and sediment controls are in place. Limit areas exposed uncontrolled to erosion during installation of temporary erosion and sediment controls.

PART 2 – MATERIALS (NOT USED)

PART 3 – EXECUTION

3.01 GENERAL

A. Clear, grub, and strip areas needed for waste disposal, borrow, or site improvements within limits specified.

B. Property obstructions, such as buildings, sewers, drains, water or gas pipes, bridges, etc., are to remain in place and to be carefully protected from damage. Exceptions are those property obstructions that are clearly shown on the plans to be demolished.

C. Vegetation not designated for removal shall not be injured or defaced. All branches potentially interfering with construction operations shall be pruned prior to starting work and following approval of the City.

3.02 LIMITS

A. As follows, but not to extend beyond project limits.

1. Excavation Including Trenches: 5 feet beyond top of cut slopes or shored wall.

2. Fill:

a. Clearing and Grubbing: 5 feet beyond toe of permanent fill.

b. Stripping and Scalping: 2 feet beyond toe of permanent fill.

3. Waste Disposal:

a. Clearing: 5 feet beyond perimeter.

b. Scalping and Stripping: Not required.

c. Grubbing: Around perimeter as necessary for neat, finished appearance.

4. Overhead Utilities:

a. Clearing, Grubbing, Scalping, and Stripping: Wherever grading is required, including borrow pits, ditches, etc.

b. Other Areas: As shown.

B. Remove and legally dispose of all rubbish, trash, and junk from entire area within Project limits.

3.03 TEMPORARY REMOVAL OF INTERFERING PLANTINGS

A. Remove and store, as specified in the Contract Documents, trees, plants, and ground covers, shrubs and trees not designated for removal but do interfere with construction or could be damaged by construction activities.

B. Photograph and document location, orientation, and condition of each plant prior to its removal. Record sufficient information to uniquely identify each plant removed and to assure accurate replacement.

3.04 CLEARING

A. Clear areas within limits specified.

B. Fell trees so they fall away from facilities and vegetation not designated for removal.

C. Cut stumps not designated for grubbing 12 inches below the ground surface.

D. Cut off shrubs, brush, weeds, and grasses to within 2 inches of ground surface.

3.05 GRUBBING

A. Grub areas within limits specified.

3.06 SCALPING

A. Do not remove sod until after clearing and grubbing is completed and resulting debris is removed.

B. Scalp areas within limits specified.

3.07 STRIPPING

A. Do not remove topsoil until scalping is completed.

B. Strip areas within limits to minimum depths specified. Do not remove subsoil with topsoil.

C. Stockpile strippings, meeting requirements of Section 31 31 00, Soil Preparation, for topsoil, separately from other excavated material.

3.08 TREE REMOVAL OUTSIDE CLEARING LIMITS

A. Remove Within Project Limits:

1. Dead, dying, leaning, or otherwise unsound trees that may strike and damage Project facilities in falling.

2. Trees designated by Engineer.

3. Cut stumps off flush with ground, remove debris, grind stump and if disturbed, restore surrounding area to its original condition.

3.09 TREE TOPPING

A. Top trees designated by the City so remaining portion will not strike facilities in falling. Where topping will remove more than 1/2 of a tree's crown, remove entire tree.

B. Treat wounds resulting from topping in accordance with standard horticultural practice to preserve the natural character of the tree.

3.10 PRUNING

A. Remove branches below the following heights:

1. Sixteen feet above roadways and shoulders.

2. Nine feet above sidewalks.

3. Six feet above roofs.

B. Prune only after planting and in accordance with standard horticultural practice to preserve the natural character of the plant. Perform in presence of the Engineer. Remove all dead wood, suckers, and broken or badly bruised branches. Use only clean, sharp tools. Do not cut lead shoot.

3.11 DISPOSAL

A. Clearing and Grubbing Debris:

1. Woody debris may be chipped. Chips may be sold to the Contractor's benefit or used for landscaping onsite as mulch or uniformly mixed with topsoil, provided that resulting mix will be fertile and not support combustion. Maximum dimensions of chipped material used onsite shall be 1/4-inch by 2 inches. Dispose of chips that are unsaleable or unsuitable for landscaping or other uses with unchipped debris.

2. Limit offsite disposal of clearing and grubbing debris to locations approved by federal, state, and local authorities, and that will not be visible from Project.

B. Scalpings: As specified for clearing and grubbing debris.

C. Strippings:

1. Dispose of strippings that are unsuitable for topsoil or that exceed quantity required for topsoil offsite or in waste disposal areas approved by Engineer.

2. Stockpile topsoil in sufficient quantity to meet Project needs. Dispose of excess strippings as specified for clearing and grubbing.

END OF SECTION

SECTION 31 23 13
SUBGRADE PREPARATION

PART 1 – GENERAL

1.01 DEFINITIONS

A. Prepared Ground Surface: Ground surface after completion of clearing and grubbing, scalping of sod, stripping of topsoil, excavation to grade, and scarification and compaction of subgrade.

B. Subgrade: Layer of existing soil after completion of clearing, grubbing, scalping of topsoil prior to placement of fill, roadway structure or base for floor slab.

C. Proof-Rolling: Testing of subgrade by compactive effort to identify areas that will not support the future loading without excessive settlement.

1.02 SUBSURFACE CONDITIONS

A. Information on subsurface conditions is referenced under Division 01, General Requirements.

B. A separate geotechnical report is included in Appendix A as a reference for information purposes. The report identifies properties below grade and also offers recommendations for surface preparation including silt strata removal, backfill and compaction requirements, shallow foundation requirements, and grade slabs. Review recommendation for excavation and removal of existing unsuitable subgrade material, and backfill and compaction requirements for new material.

1.03 QUALITY ASSURANCE

A. Notify Engineer when subgrade is ready for compaction or proof-rolling or whenever compaction or proof-rolling is resumed after a period of extended inactivity.

B. The Contractor is required to retain a materials testing firm as specified in Section 01 40 00. It is the Contractor's materials testing firm responsibility to determine if materials are "soft", "loose", or "unsuitable".

1.04 RELATED WORK SPECIFIED ELSEWHERE

A. Requirements of related work are included in Divisions 01, 02, and 31 of these Specifications.

PART 2 – MATERIALS (NOT USED)

PART 3 – PART 3 – EXECUTION

3.01 GENERAL

A. Keep subgrade free of water, debris, and foreign matter during compaction or proof-rolling.

B. Bring subgrade to proper grade and cross-section and uniformly compact surface.

C. Do not use sections of prepared ground surface as haul roads. Protect prepared subgrade from traffic.

D. Maintain prepared ground surface in finished condition until next course is placed.

3.02 SILT STRATA REMOVAL

A. Remove silt strata in the plan area of the proposed new structural foundations plus a distance of 10 feet.

B. If the proposed excavations for removal of the silt strata undermine or weaken foundation soils for existing structures of adjacent buildings, then earth retention systems will be necessary to be designed and installed by the Contractor to support lateral earth pressure.

C. Install backfill materials. Backfill materials shall be Granular Fill as specified in Section 31 23 23 – Fill and Backfill.

3.03 COMPACTION

A. Under Earth fill: Compact upper 6 inches to minimum of 80 percent of the maximum density as determined by AASHTO T99, Method C.

B. In Areas of Silt Strata Removal and Replacement with Granular Fill: Once fill soils have been placed 1 foot above the dewatered groundwater level (initial lift), then entire lift shall be rolled with six passes of a 10-ton roller with overlapping coverages at a compactor travel speed of not more than 2 feet per second. Do not use vibratory compactor (i.e., operate compactor with vibrator off). Fill soils placed following the initial lift shall be compacted to 95 percent of the maximum dry density as determined by AASHTO T180, Modified Proctor.

C. Under Pavement, Floor Slabs on Grade, or Granular Fill under Structures: Compact the upper 12 inches or as shown on the Drawings, to minimum of 95 percent of the maximum dry density as determined by AASHTO T180, Modified Proctor.

3.04 MOISTURE CONDITIONING

A. Dry Subgrade: Add water, then mix to make moisture content uniform throughout.

B. Wet Subgrade: Aerate material by blading, discing, harrowing, or other methods, to hasten drying process.

3.05 TESTING

A. Proof-roll subgrade to detect soft or loose subgrade or unsuitable material, as determined by Contractor's materials testing firm.

3.06 CORRECTION

A. Soft or Loose Subgrade:

1. Adjust moisture content and recompact, or

2. Over excavate and replace with suitable material from the excavation, as specified in the Contract Documents.

3. Unsuitable Material: Over excavate and replace with suitable material from the excavation, as specified in the Contract Documents.

END OF SECTION

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SECTION 31 23 16
EXCAVATION

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. Furnish all labor, equipment and materials required to complete all work associated with excavation, including off-site borrow excavation, dewatering, backfill, drainage layers beneath and around structures, foundation and backfill stone, filter fabric, embankments, stockpiling topsoil and any excess suitable material in designated areas, in place compaction of embankments, backfill and subgrades beneath foundations and roadways, excavation support, disposing from the site all unsuitable materials, providing erosion and sedimentation control grading, site grading and preparation of pavement and structure subgrade, and other related and incidental work as required to complete the work shown on the Drawings and specified herein.

B. All excavations shall be in conformity with the lines, grades, and cross sections shown on the Drawings or established by the Engineer.

1.02 SUBSURFACE CONDITIONS

A. Information on subsurface conditions is referenced under Division 01, General Requirements.

B. A separate geotechnical report is included in Appendix A as a reference for information purposes. The report identifies properties below grade and also offers recommendations for surface preparation including silt strata removal, backfill and compaction requirements, shallow foundation requirements, and grade slabs. The recommendations shall not be construed as requirements of the Contract unless specifically referenced by the Contract Documents.

C. The Owner and/or the Engineer will not assume responsibility for variations of sub-soil quality or conditions at locations other than places shown and at the time the geotechnical investigation was made. The Contractor shall examine the site and review the available geotechnical boring logs or undertake its own subsurface investigation prior to submitting its bid, taking into consideration all conditions that may affect its work.

D. The Contractor shall satisfy itself as to the character and amount of different soil materials, groundwater and the subsurface conditions to be encountered in the work to be performed. Information and data, when furnished, are for the Contractor's general information. However, it is expressly understood that any interpretation or conclusion drawn there from is totally the responsibility of the Contractor. Engineer and City assume no liability for the accurateness of the data reported. No claim for extra compensation or

for extension of time will be allowed on account of subsurface conditions inconsistent with Contractor's assumptions.

E. Attention is directed to the fact that there may be water pipes, plant drains, and other utilities located in the area of proposed excavation. Locate existing underground utilities in areas of work. Test pits and hand excavation in critical areas will be required prior to initiating work. Perform all repairs to same in the event that excavation activities disrupt service.

F. All existing utilities including piping, electrical conduits, electrical duct banks and telephone cables that are shown on the Contract Documents to be relocated, shall be relocated prior to initiating earthwork. Excavation and backfill for relocation of existing utilities shall conform to the requirements of Section 31 23 33 – Trenching and Backfill. The Contractor shall coordinate relocation of utilities with utility companies having jurisdiction in the area. Should unknown or incorrectly identified piping or other utilities be encountered during excavation, the Contractor shall consult the City and the Engineer immediately for directions.

G. The Contractor shall cooperate with the Owner and utility companies in keeping respective services and facilities in operation.

1.03 QUALITY ASSURANCE

A. Provide adequate survey control to avoid unauthorized over-excavation.

1.04 WEATHER LIMITATIONS

A. Material excavated during inclement weather shall not be used as fill or backfill until after material drains and dries sufficiently for proper compaction.

1.05 SEQUENCING AND SCHEDULING

A. Clearing, Grubbing, and Stripping: Complete applicable work specified in Contract Documents prior to excavating.

B. Contractor shall call the utility companies 72 hours before excavation per the requirements of the Contract Documents.

1.06 SUBMITTALS

A. In accordance with the procedures and requirements set forth in Section 01 33 00 – Submittal Procedures, the Contractor shall submit the following:

1. List of disposal sites for waste and unsuitable materials and all required permits for use of those sites.

2. Plans and cross sections of open cut excavations showing side slopes and limits of the excavation at grade.

3. Procedures for dewatering proposed by the Contractor shall be submitted to the Engineer for review and approval prior to any earthwork operations.

4. Samples of synthetic filter fabric and reinforced plastic membrane with manufacturer's certificates or catalog cuts stating the mechanical and physical properties. Samples shall be at least one (1) foot wide and four (4) feet long taken across the roll with the warp direction appropriately marked.

5. Construction drawings and structural calculations for any types of excavation support required. Drawings and calculations shall be signed and sealed by a currently registered Professional Engineer in the State of Florida.

6. Monitoring plan and pre-construction condition inspection and documentation of all adjacent structures, utilities, and roadways near proposed installation of excavation support systems and near areas where dewatering is required to facilitate construction.

7. The Contractor shall not place any foundation reinforcement steel or formwork until excavations have been tested for compaction.

8. The Contractor shall apply for and obtain all necessary permits for dewatering as necessary. Contractor shall be responsible for all permit fees.

1.07 GROUNDWATER

A. The Contractor shall be responsible for anticipating groundwater conditions and shall provide positive control measures as required. Such measures shall ensure construction in the dry, stability of excavations, groundwater pressure control, prevention of tanks, pipes, and other structures from being lifted by hydrostatic pressures, and avoiding the disturbance of subgrade bearing materials.

B. Dewatering requirements shall be as specified in Section 31 23 19 - Dewatering.

PART 2 – MATERIALS (NOT USED)

PART 3 – EXECUTION

3.01 GENERAL

A. Prepare site in accordance with Section 31 12 00 – Site Preparation.

B. Excavate to lines, grades, and dimensions shown and as necessary to accomplish Work. Excavate to within tolerance of plus or minus 0.1 foot except where dimensions or grades

are shown or specified as maximum or minimum. Allow for forms, working space, granular base, topsoil, and similar items, wherever applicable. Trim to neat lines where concrete is to be deposited against earth.

C. It shall be the Contractor's responsibility to notify business establishments and residents not less than 72 hours prior to construction. Contractor shall provide temporary sidewalks and driveway entrances at his own expense, including safe bridges over trenches and fencing around excavations for pedestrian protection.

D. Provide adequate survey control to avoid unauthorized over excavation. Do not over excavate without written authorization of Engineer. If the Contractor excavates beyond the limits shown or specified, the Contractor shall replace such excavation at his own expense.

E. Replace over excavated material as specified in Contract Documents. Note that Section 31 23 23 - Fill and Backfill specifies specific materials for filling of over excavated areas based on the intended service.

F. Where muck, rock, clay, or other material within the limits of excavation is unsuitable in its original position, excavate such material to the cross-sections shown or specified. Backfill with suitable material and shape to the required cross-section.

G. Remove or protect obstructions as shown on the Drawings.

3.02 UNCLASSIFIED EXCAVATION

A. Excavation is unclassified. Complete all excavation regardless of the type, nature, or condition of the materials encountered.

3.03 TRENCH WIDTH

A. Minimum Width of Trenches:

1. Single Pipes, Conduits, Direct-Buried Cables, and Duct Banks:

   a. Less than 4-Inch Outside Diameter or Width: 18 inches.

   b. Greater than 4-Inch Outside Diameter or Width: 18 inches greater than outside diameter or width of pipe, conduit, direct-buried cable, or duct bank.

2. Multiple Pipes, Conduits, Cables, or Duct Banks in Single Trench: 18 inches greater than aggregate width of pipes, conduits, cables, duct banks, plus space between.

3. Increase trench widths by thicknesses of support of excavation, if used.

4. Trench width shall not exceed the minimum stated width unless approved by the Engineer. Restoration for excavation beyond the minimum required width shall be at the Contractor's sole expense.

B. The Contractor shall be responsible to design, provide, maintain, and remove all support of excavation as necessary to support the sides of excavations and to prevent detrimental settlement and lateral movement of existing facilities, adjacent property, and completed Work.

C. Consider all available geotechnical information available when designing the excavation support system.

D. Remove excavation support in a manner that will maintain support as excavation is backfilled.

E. Do not begin to remove excavation support until support can be removed without damage to existing facilities, completed Work, or adjacent property.

F. Remove excavation support in a manner that does not leave voids in the backfill.

G. For excavation support exceeding 5 feet in depth, provide adequate safety system meeting requirements of the Occupational Safety and Health Administration's (OSHA), Trench Safety Standards, 29 C.F.R., S.1926.650, Subpart P, and all subsequent revisions or updates adopted by the Department of Labor and Employment Security.

3.04 EMBANKMENT AND CUT SLOPES

A. Shape, trim, and finish cut slopes to conform with lines, grades, and cross-sections shown, with proper allowance for topsoil or slope protection, where shown.

B. Remove stones and rock that exceed 3-inch diameter and that are loose and may roll down slope. Remove exposed roots from cut slopes.

C. Round tops of cut slopes in soil to not less than a 6-foot radius, provided such rounding does not extend offsite or outside easements and rights-of-way, or adversely impacts existing facilities, adjacent property, or completed Work.

3.05 STOCKPILING EXCAVATED MATERIAL

A. Stockpile excavated material suitable for use as fill until material is needed.

B. Post signs indicating proposed use of material stockpiled. Post signs readable from all directions of approach to each stockpile. Signs should be clearly worded and readable by equipment operators from their normal seated position.

C. Confine stockpiles to within easements, rights-of-way, and approved work areas. Do not obstruct roads, streets, public thoroughfares, or access to fire hydrants.

D. Do not stockpile excavated material adjacent to trenches and other excavations unless excavation side slopes and excavation support systems are designed, constructed, and maintained for stockpile loads.

E. Do not stockpile excavated materials near or over existing facilities, adjacent property, or completed Work, if weight of stockpiled material could induce excessive settlement.

F. Do not stockpile excavated materials near waterways or stormwater inlets.

3.06 DISPOSAL OF SPOIL

A. Legally dispose of excavated materials, which are unsuitable or exceed quantity needed for fill, offsite.

B. Legally dispose of debris resulting from removal of organic matter, trash, refuse, and junk as specified in the Contract Documents, for clearing and grubbing debris.

END OF SECTION

SECTION 31 23 19

DEWATERING

PART 1 – GENERAL (NOT USED)

1.01 GENERAL

A. The Contractor shall be responsible for design, installation, and operation of a dewatering system to dewater specified excavations.

1. The dewatering system shall be designed in accordance with the Best Management Practices (BMP's) adopted by FDEP.

2. Inspection and control of dewatering system operations will be in accordance with the FDEP guidelines established in the Florida Erosion and Sediment Control Inspector's Manual (current edition).

B. Continuously manage and control excavation water recharge in order to facilitate and not impede construction activities at all times, including weekends, holidays, and during periods of work stoppages, and furnish and install, and operate, a contingency backup dewatering system to maintain control of excavation water levels to facilitate construction (i.e., no construction delays).

1.02 WORK INCLUDED

A. Furnish all labor, materials, and equipment, perform all work necessary to lower and control the groundwater levels and hydrostatic pressures to permit all excavations and construction to be performed in dry conditions. The work shall include the following:

1. Testing, operation, maintenance, supervision, rewatering, and final dismantling and removal from the site of the dewatering system.

2. The cost of any replacement or rehabilitation of the subgrade or structures damaged due to dewatering system failures or Contractor negligence.

3. Compliance with all regulations relating to this work.

4. The diversion, collection, and removal of all ice, snow and surface runoff from the work areas, and removal of groundwater from new excavations to permit construction in the dry.

1.03 RELATED WORK SPECIFIED ELSEWHERE

A. Requirements of related work are included in Division 01, Division 02, and Division 31 of these Specifications.

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1.04 REFERENCE SPECIFICATIONS CODES AND STANDARDS

A. Without limiting the generality of other requirements of these Specifications, all work herein shall conform to or exceed the applicable requirements of the following documents to the extent that the provisions therein are not in conflict with the requirements of this Section.

1. ASTM D1556 – Density of soil in place by the Sand Cone Method.

2. ASTM D2167 – Density of soil in place by the Rubber Balloon Method.

3. Bureau of Reclamation – Groundwater Manual Sediment Test by Imhoff Cone

1.05 SUBMITTALS

A. Submittals shall be made in accordance with the requirements specified in Contract Documents and the requirements of this Section.

B. Provide name, address, and phone numbers of all subcontractors.

C. The Contractor shall submit a Dewatering Best Management Practices (BMP) Plan prior to the start of excavation expected to include dewatering operations. The Plan shall provide detailed descriptions of dewatering procedures to be utilized to meet the requirements of this Section. Methodologies to control dewatering discharge contamination include, but are not limited to:

1. Holding tanks of adequate size and volume.

2. Wellpoint systems.

3. Sump pumping systems.

4. Chemical precipitation of particulates.

5. Filter systems and siltation controls.

6. Outfall booms.

D. The Contractor shall provide a Site Health and Safety Plan and Activity Hazard Analysis (AHA) for contaminated soil as specified in the Contract Documents and/or groundwater as specified in this Section, to include the following:

1. A written description of the proposed method for temporary stockpiling, transportation, and disposal of all wastes.

2. Copy of permits of disposal facilities.

3. Certification of disposal of all wastes.

4. Directions to the nearest hospital and phone number.

5. Emergency contact phone numbers.

6. Laboratory analyses and sampling plan required for transportation and disposal of all wastes in accordance with applicable federal, state, and local requirements.

E. Upon Completion of Remediation Activities, the following shall be provided:

1. Copy of manifests for all wastes leaving the site.

2. Copy of the laboratory analyses results from all sampling activities.

3. Copy of of all required closure reports.

1.06 QUALITY ASSURANCE

A. The Contractor shall be solely responsible for the arrangement, location, and depths of the dewatering system necessary to accomplish the work described herein.

B. Dewatering shall prevent the loss of fines, seepage, boils, quick conditions or softening of the foundation strata while maintaining stability of the sides and bottom of the excavation and providing dry conditions for construction operations.

PART 2 – MATERIALS (NOT USED)

PART 3 – EXECUTION

3.01 EXAMINATION OF THE SITE

A. Become familiar with the surface and subsurface site conditions.

B. Obtain the data required to analyze the water and soil environment at the site in order to assure that the materials used for the dewatering systems will not erode, deteriorate, clog or otherwise hinder the system's performance during the period of the dewatering.

C. Prior to the execution of the work, the Contractor, Owner and Engineer shall jointly survey the condition of adjoining structures. Photographs and records shall be made of any prior settlement or cracking of structures, pavements, and the like, that may become the subject of possible damage claims.

3.02 SURFACE WATER CONTROL

A. Remove surface runoff controls when no longer needed.

B. Seal off or berm catch basins, channels, waterways, etc. in the area of construction to prevent discharge of untreated dewatering effluent or runoff from unstabilized construction areas into storm drains or waterways.

C. All drain inlets, catch basins, or other drainage features used for dewatering discharge shall be provided with silt and sediment removal barriers as approved by the Engineer.

1. All barriers shall be cleaned regularly to avoid sediment discharge into the storm drain system or waterways.

2. Construction activities will be stopped at no cost to the City until sediment controls are properly maintained, installed, and in compliance with the dewatering permit.

3. All barriers shall be removed upon issuance of a hurricane warning.

3.03 DEWATERING SYSTEMS

A. Design, furnish, and install, operate, and maintain a dewatering system of sufficient size and capacity to permit excavation and subsequent construction activities in water-free conditions, and to lower and maintain the excavation area groundwater level a minimum of 2 feet below the lowest point of excavation. The dewatering system shall be designed and operated such that the system continuously maintains excavations water allowing for the initiation and completion of excavation backfill compaction and restoration activities.

B. Dewatering systems shall include, but is not limited to, furnishing and installing wells or well points, and or other equipment and appurtenances as may be necessary, including system components or equipment, installed outside the outermost perimeter of the excavation limits, and sufficiently below lowest point of excavation, to maintain the specified or required groundwater elevation.

C. Open trench pumping shall be permitted only upon approval of the Engineer.

D. Design and Operate Dewatering Systems:

1. To prevent loss of ground as water is removed.

2. To avoid inducing settlement or damage to existing facilities, completed Work, or adjacent property.

3. Avoid surface water pollution or discharge of sediment to storm drain systems or waterways.

E. Provide supplemental ditches and sumps only as necessary to collect water from local seeps. Do not use ditches and sumps as primary means of dewatering. The Contractor shall not direct any flow of water over pavement surfaces. Discharge of water shall be conducted as approved by the local, state, and federal agencies and the Engineer.

F. Provide controls to prevent surface water from entering excavation pits, trenches, or stockpiled materials.

3.04 PIPELINES CONSTRUCTED UNDER WATER

A. In the event the water in a trench cannot be lowered by ordinary means, i.e., well points and pumps, an alternate construction method may be proposed by the Contractor. Complete details, specifications, manufacturer's descriptive literature, installation lists and any other pertinent data regarding the proposed alternate method shall be submitted as an alternate by the Contractor to the City within 5 calendar days of the time that the Contractor anticipates using such alternate method.

B. If the City approves the alternate method in writing, it may be used, so long as the Work is performed in a manner which, in the opinion of the Engineer, conforms to the method and procedure as set forth in the information supplied by the Contractor in his original application for use of an alternate method. The City may revoke approval of the alternate method if at any time, in his opinion, the Work is not conforming to any applicable portion of these Specifications.

C. No pipeline shall be laid under water without approval of the City.

D. If the dewatering system is eliminated or the effort reduced, and the pipe is laid underwater, additional pipe zone material will be required as backfill to the water table elevation, or to the level it was reduced to.

3.05 DISPOSAL OF WATER

A. All water generated, pumped, or removed from excavations as a result of excavation dewatering activities shall be collected, containerized, and managed prior to discharge and or treatment at an approved discharge point or facility, in accordance with Broward County Code of Regulation, Sections 27. Contractor shall secure, obtain, and pay for all necessary local, state, and federal permits, licenses, fees, and or approvals to discharge water or perform onsite or offsite treatment and disposal. Treat water collected by dewatering operations as required by regulatory agencies, prior to discharge.

B. Discharge water as permitted, and in regulatory compliance with Contractor obtained discharge permits/licenses.

1. All discharge activities shall be performed so as to prevent silt and sediment discharge and eliminate any soil erosion or flooding, or otherwise damage existing facilities, completed Work, or adjacent property.

2. Maximum allowable turbidity of discharges to surface waters or storm drains will be 10 NTU's or the maximum permitted by the agency having jurisdiction, whichever is less.

3. Sump discharges cannot be discharged directly to storm drains or surface waters without treatment.

C. Affected storm sewer outfalls shall be protected with floating silt booms as approved by the Broward County Resilient Environment Department (BCRED) and the Engineer. All accumulated debris resulting from the dewatering discharge collecting in the boom shall be removed on a daily basis.

D. Visible silt plumes emanating from the area around the outfalls will be considered a failure of the silt and sediment removal measures and may result in a Notice of Violation issued by BCRED. The Contractor will be responsible for all fines associated with the violation of the dewatering permit conditions issued to the Contractor.

E. Failure to control dewatering discharges as described above and as detailed in the Florida Erosion and Sediment Control Inspector's Manual may result in an order to cease dewatering operations until the discharge problems are corrected. No claims will be accepted for costs or delays associated with unacceptable dewatering discharge practices.

3.06 WELL POINT REMOVAL

A. Well point holes shall be filled with sand which shall be washed into the hole.

B. Well point holes located within asphalt pavement surfaces or concrete pavements, shall be filled with sand to the subgrade. The remaining hole shall be filled with non-shrink grout.

3.07 CONTAMINATED GROUNDWATER AND DISPOSAL REQUIREMENTS

A. If Contractor suspects, witnesses, or identifies, groundwater contamination at any time during the performance of the Work, Contractor shall notify the City immediately. Results will be obtained by the onsite mobile laboratory.

B. If analytical testing documents and indicates elevated concentrations above FDEP action levels (Chapter 62-777, Florida Administrative Code) dewatering operations will be suspended until appropriate treatment and or construction measures can be implemented. Contractor shall not resume operations until notified to do so in writing by the City and construction of the remaining pipelines in that area will be installed in the wet or normal construction activities shall be resumed in another areas determined by the Engineer. There shall be no delay or mobilization claim associated with moving to another project area, unless all other Work has been completed. In addition, the local agency will be immediately notified via telephone and in writing by the Contractor. Dewatering activities in the area will not proceed until review of the matter with the local agency is resolved and written authorization is issued.

C. The Contractor shall submit a dewatering plan to the City for review. The Contractor is advised that the SFWMD, FDOT, BCRED, etc. may require that a dewatering plan, prepared by a state of Florida licensed Professional Engineer or registered Professional

Geologist, be submitted and approved prior to issuance of a dewatering permit. The Contractor will retain a state of Florida licensed Professional Engineer or registered Professional Geologist to provide an initial report of potential dewatering issues in the site vicinity. The Contractor shall retain a state of Florida licensed Professional Engineer or registered Professional Geologist to provide any additional services required by regulatory agencies regarding dewatering and contaminated sites.

D. The Contractor is advised that the BCRED may have identified contaminated sites within ¼ mile radius of the project site. The Contractor may be required to provide testing and monitoring of the dewatering operations, and to institute dewatering methods and controls, as required by BCRED, SFWMD, FDOT etc. The contractor will be responsible for all costs associated with means and methods of dewatering which will be set forth by dewatering permits.

E. Treatment of the groundwater will include three options depending on the magnitude of the contamination in the trench or as determined by the Engineer: Granular Activated Carbon (GAC) Treatment Vessels, Mobile Air Stripping Units, or Vacuum Truck Removal and Disposal or other method as approved by the Engineer. The Contractor shall provide a submittal list of all qualified groundwater remediation subcontractors for GAC vessel treatment/portable air stripping unit and vacuum truck disposal including phone numbers, contact names, and addresses prior to start of construction. The selected groundwater treatment/recycling facility for hauling contaminated groundwater shall also be identified.

F. If contaminated groundwater in the dewatering trench is encountered, remediation operations shall begin once local agency approval is obtained. Contaminated water shall be disposed first into a high volume holding (FRAC) tank and then treated through a GAC unit/portable air stripper or recovered into vacuum hauling trucks for disposal.

G. Effluent water from the treatment system will be analyzed by the onsite mobile laboratory to confirm concentrations are below regulatory limits. Effluent water shall then be directed to a pre-approved alternative location as determined by local agency and/or the Engineer.

END OF SECTION

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SECTION 31 23 23

FILL AND BACKFILL

PART 1 – GENERAL

1.01 DEFINITIONS

A. Prepared Ground Surface: Ground surface after completion of required demolition, clearing and grubbing, scalping of sod, stripping of topsoil, excavation to grade, and subgrade preparation.

B. Completed Course: A course or layer that is ready for next layer or next phase of Work.

C. Lift: Loose (uncompacted) layer of material.

D. Geosynthetics: Geotextiles, geogrids, or geomembranes.

E. Well-Graded:

1. A mixture of particle sizes with no specific concentration or lack thereof of one or more sizes.

2. Used to define material type that, when compacted, produces a strong and relatively incompressible soil mass free from detrimental voids.

F. Influence Area: Area within planes sloped downward and outward at 60-degree angle from horizontal measured from:

1. 1-foot outside outermost edge at base of foundations or slabs.

2. 1-foot outside outermost edge at surface of roadways or shoulder.

3. 0.5-foot outside exterior at spring line of pipes or culverts.

G. Borrow Material: Material from required excavations or from designated borrow areas on or near site.

H. Selected Backfill Material: Materials available onsite that Contractor's materials testing firm determines to be suitable for specific use.

I. Imported Material: Materials obtained from sources offsite, suitable for specified use.

J. Structural Fill: Fill materials as required under structures, pavements, and other facilities.

K. Embankment Material: Fill materials required to raise existing grade in areas other than under structures.

1.02 QUALITY CONTROL

A. Contractor's Lab: Laboratory testing and checking and all certifications required by the Specifications, including the cost of transporting all samples and test specimens, shall be provided and paid for by the Contractor unless otherwise indicated in the Specifications.

B. Owner's Lab: An independent testing laboratory may be retained by the Owner to do its own testing.

PART 2 – MATERIALS

2.01 EARTHFILL

A. Excavated material from required excavations and designated borrow sites, free from rocks larger than 3 inches, from roots and other organic matter, ashes, cinders, trash, debris, and other deleterious materials.

B. Material containing more than 10 percent gravel, stones, or shale particles is unacceptable.

C. Provide imported material of equivalent quality, if required to accomplish Work.

2.02 GRANULAR FILL

A. Use graded aggregate base material of uniform quality throughout, substantially free from vegetable matter, shale, lumps and clay balls, and having a Limerock Bearing Ratio value of not less than 100.

B. Aggregate is composed of limestone, marble, or dolomite.

C. Use material retained on the No. 10 sieve composed of aggregate meeting the following requirements:

1. Soundness Loss, Sodium, Sulfate: AASHTO T 104, 15 percent.

2. Percent Wear: AASHTO T 96 (Grading A) 45 percent.

Sieve Size	Percent by Weight Passing
2 inch	100
1-1/2 inch	95 to 100
¾ inch	65 to 90
3/8 inch	45 to 75
No. 4	35 to 60
No. 10	25 to 45

Sieve Size	Percent by Weight Passing
No. 50	5 to 25
No. 200	0 to 10

2.03 WATER FOR MOISTURE CONDITIONING

A. Free of hazardous or toxic contaminates, or contaminants deleterious to proper compaction.

2.04 FOUNDATION STABILIZATION ROCK

A. General: Materials may be either limerock, shell rock, cemented coquina, or shell base sources approved by the FDOT.

B. Specific Requirements for Limerock: For limerock, carbonates of calcium and magnesium shall be at least 70 percent. Materials having a plasticity index of more than ten or a liquid limit greater than 40 shall not be used as a stabilizer. The gradation of limerock shall be FDOT No. 57 stone or such that 97 percent of these materials will pass a 3-1/2 inch sieve.

C. Crushed Shell: Crushed shell for this use shall be mollusk shell (i.e., oysters, mussels, clams, cemented coquina). Steamed shell will not be permitted.

D. Crushed shell shall meet the following requirements:

1. Material having a plasticity index of more than ten or a liquid limit greater than 40 shall not be used as a stabilizer.

2. At least 97 percent by weight of the total material shall pass a 3-1/2 inch sieve and at least 50 percent by weight of the total material shall be retained on the No. 4 sieve.

3. Not more than 20 percent by weight of the total material shall pass the No. 200 sieve. The determination of the percentage passing the No. 200 sieve shall be by washing only.

4. If the shell meets the above requirements without crushing, crushing will not be required.

PART 3 – EXECUTION

3.01 GENERAL

A. Keep placement surfaces free of water, debris, and foreign material during placement and compaction of fill and backfill materials.

B. Place and spread fill and backfill materials in horizontal lifts of uniform thickness, in a manner that avoids segregation, and compact each lift to specified densities prior to placing succeeding lifts. Slope lifts only where necessary to conform to final grades or as necessary to keep placement surfaces drained of water.

C. During filling and backfilling, keep level of fill and backfill around each structure, buried tank, etc. even.

D. If Pipe, Conduit, Duct Bank, or Cable is to be laid within Fill or Backfill:

1. Fill or backfill to an elevation 2 feet above top of item to be laid.

2. Excavate trench for installation of item.

3. Install bedding, if applicable, as specified in the Section 31 23 33 - Trenching and Backfilling.

4. Install item.

5. Backfill pipe zone and remaining trench, as specified in the Section 31 23 33 - Trenching and Backfilling, before resuming filling or backfilling specified in this Section.

E. Tolerances:

1. Final Lines and Grades: Within a tolerance of 0.1 foot, unless dimensions or grades are shown or specified otherwise.

2. Grade to establish and maintain slopes and drainage as shown. Reverse slopes are not permitted.

F. Settlement: Correct and repair any subsequent damage to structures, pavements, curbs, slabs, piping, and other facilities, caused by settlement of fill or backfill material.

3.02 BACKFILL UNDER AND AROUND STRUCTURES

A. Under Facilities: Within influence area beneath structures, slabs, pavements, curbs, piping, conduits, duct banks, and other facilities, backfill with granular fill, unless otherwise shown. Place granular fill in lifts of 6-inch maximum thickness and compact each lift to a density of at least 100 percent of the maximum density as determined by AASHTO T99, Method C.

3.03 FILL

A. Outside Influence Areas Beneath Structures, Pavements, Curbs, Slabs, Piping, and Other Facilities: Unless otherwise shown, place earthfill as follows:

1. Allow for proper thickness of topsoil where required.

2. Maximum 8-inch thick lifts.

3. Place and compact fill across full width of embankment.

4. Compact to a density of at least 80 percent of the maximum density as determined by AASHTO T99, Method C.

5. For the outer layer of all fill where plant growth will be established, DO NOT COMPACT. Leave this layer in a loose condition to a minimum depth of 6 inches.

6. Dress completed embankment with allowance for topsoil, crest surfacing, and slope protection, where applicable.

3.04 SITE TESTING

A. Gradation:

1. One sample from each 1,500 tons of finished product or more often as determined by Engineer, if variation in gradation is occurring, or if material appears to depart from Specifications.

2. If test results indicate material does not meet Specification requirements, terminate material placement until corrective measures are taken.

3. Remove material placed in Work that does not meet Specification requirements.

B. In-Place Density Tests: In accordance with AASHTO T99, Method C. During placement of materials, test as follows:

1. Earthfill: One test per 400 feet of pipe run.

2. Granular Fill: One test per 400 feet of pipe run.

3. Foundation Stabilization Rock: One test per lift.

3.05 REPLACING OVEREXCAVATED MATERIAL

A. Replace excavation carried below grade lines shown or established by City as follows:

1. Beneath Footings: Granular fill.

2. Beneath Fill or Backfill: Same material as specified for overlying fill or backfill.

3. Beneath Slabs-On-Grade: Granular fill.

4. Trenches:

a. Unauthorized Over excavation: Either foundation stabilization rock or granular pipe base material, as specified in the Section 31 23 33 - Trenching and Backfilling.

b. Authorized Over excavation: Foundation stabilization rock.

5. Permanent Cut Slopes (Where Overlying Area is Not to Receive Fill or Backfill):

a. Flat to Moderate Steep Slopes (3 to 1, Horizontal Run: Vertical Rise or Flatter): Earthfill.

b. Steep Slopes (Steeper than 3 to 1):

1) Correct over-excavation by transitioning between over-cut areas and designed slope adjoining areas, provided such cutting does not extend offsite or outside easements and right-of-ways, or adversely impacts existing facilities, adjacent property, or completed Work.

2) Backfilling over excavated areas is prohibited unless, in Engineer's opinion, backfill will remain stable, and over excavated material is replaced as compacted earthfill.

END OF SECTION

SECTION 31 23 24

FLOWABLE FILL

PART 1 – GENERAL

1.01 WORK INCLUDED

A. The Contractor shall furnish all labor, equipment, materials and services, including pumping equipment and application, necessary for the manufacture, transportation and placement of all cementitious flowable fill as shown on the Contract Drawings or as ordered by the Engineer, except for the work specifically included under other items.

1.02 SUBMITTALS

A. Comply with the Section titled “Submittal Procedures”.

B. Contractor shall submit the following:

1. Shop Drawings
2. Certifications of specification compliance for all sources of each material
3. Manufacturer’s data on all admixtures
4. Mix design and trial mix test results
5. Aggregate gradation

1.03 STANDARDS

A. ASTM C143: Standard Test Method for Slump of Hydraulic-Cement Concrete

B. ASTM D6023: Standard Test Method for Density (Unit Weight), Yield, Cement Content, and Air Content (Gravimetric) of Controlled Low-Strength Material (CLSM)

C. ASTM D6024: Standard Test Method for Ball Drop on Controlled Low Strength Material (CLSM) to Determine Suitability for Load Application

1.04 QUALITY CONTROL

A. The Contractor shall engage the services of a testing laboratory experienced in the design and testing of flowable fill materials and mixes, to perform material evaluation tests and to design mixes for flowable fill.

B. A trial mix shall be performed to verify the flowable fill mix design. The trial mix shall also report slump, air content, yield, cement content, and dry unit weight per ASTM C143 and ASTM D6023.

PART 2 – MATERIALS

2.01 CEMENTITIOUS FLOWABLE FILL

A. Flowable fill (controlled low strength material) shall be a uniform mixture of sand, Type II Portland cement, fly ash, admixtures and water. The mix design shall produce a flowable material with little or no bleed water, which produces a minimum compressive strength of 50 psi and maximum compressive strength of 100 psi at 56 days. The cured material shall be excavatable and have a maximum dry weight of 100 pounds per cubic foot. Slump of mix at the point of application shall be 7-inches to 10-inches.

B. Admixtures specifically designed for flowable fill shall be used to improve flowability, reduce unit weight, control strength development, reduce settlement and reduce bleed water. Admixtures shall be Mastercell 25 by BASF Construction Chemicals; Darafill by Grace Construction Products; or approved equal.

C. Cement and all other materials shall be as specified in the Section titled “Cast-in-Place Concrete”.

D. Fine Aggregate (Sand) shall consist of natural or manufactured siliceous sand, clean and free from deleterious substances, and graded within the following limits:

Sieve Size	**Percent Passing by Weight**
3/8"	100
No. 4	95 to 100
No. 8	80 to 100
No. 16	50 to 85
No. 30	25 to 60
No. 50	10 to 30
No. 100*	2 to 10

**For manufactured sand, the percent passing the No. 100 Sieve may be increased up to 20%.*

PART 3 – EXECUTION

3.01 PLACEMENT OF FLOWABLE FILL

A. Flowable fill shall be batched and premixed by an approved producer, dispensed from ready-mix trucks, and placed by approved methods and equipment.

B. Flowable fill shall be placed as needed to completely fill the space to receive it with no trapped air pockets or other voids. Positive means of allowing the air to escape shall be provided where necessary and after approval of the Engineer. Where placed against, around and inside existing structures, lift heights shall be limited so as not to overload the structure. The Engineer shall approve lift heights and procedures. Specific procedures and methods shall be included in the Contractor's shop drawing submittals.

C. Where flowable fill is placed around piping and other elements subject to floating within the fill space, positive means shall be taken to provide temporary balancing loads to prevent uplift or fill lift heights shall be limited to prevent uplift.

D. Application of loads or placement of other fill materials or concrete on top of flowable fill shall not occur until the flowable fill surface is determined to be suitable for loading per ASTM D6024 subject to the approval of the Engineer.

END OF SECTION

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SECTION 31 23 33
TRENCHING AND BACKFILLING

PART 1 – GENERAL

1.01 DEFINITIONS

A. Base Rock: Granular material upon which manhole bases and other structures are placed.

B. Bedding Material: Granular material upon which pipes, conduits, cables, or duct banks are placed.

C. Imported Material: Material obtained by the Contractor from source(s) offsite.

D. Lift: Loose (uncompacted) layer of material.

E. Pipe Zone: Backfill zone that includes full trench width and extends from prepared trench bottom to an upper limit above top outside surface of pipe, conduit, cable or duct bank.

F. Prepared Trench Bottom: Graded trench bottom after excavation and installation of stabilization material, if required, but before installation of bedding material.

G. Selected Backfill Material: Material available onsite that Contractor's laboratory determines to be suitable for a specific use. It is the intent of these specifications to obtain clean sandy material passing through a 3/4-inch sieve as select backfill material for utility and structural applications.

H. Well-Graded: A mixture of particle sizes that has no specific concentration or lack thereof of one or more sizes producing a material type that, when compacted, produces a strong and relatively incompressible soil mass free from detrimental voids. Well-Graded does not define any numerical value that must be placed on the coefficient of uniformity, coefficient of curvature, or other specific grain size distribution parameters.

1.02 ABBREVIATIONS

A. FDOT: Florida Department of Transportation

1.03 SUBMITTALS

A. General: Submit information and samples to the Engineer for review as specified herein in accordance with Section 01 33 00 - Submittal Procedures.

B. Bedding and Backfill Materials: The Contractor shall notify the Engineer in writing of the sources of each material at least ten calendar days prior to the anticipated use of the materials.

C. Support of Excavation System: Drawings of the support of excavation system and design computations shall be submitted to the Engineer; however, the review of these drawings shall in no way relieve the Contractor of the responsibility to provide a safe and satisfactory sheeting and shoring system. Sheeting and shoring shall be designed by the Contractor, and the proposed design shall be sealed by a Professional Engineer registered in the State of Florida. If the Engineer is of the opinion that at any point sufficient or proper support has not been provided, it may order additional supports put in at the Contractor's expense.

D. Dewatering Permits: If the quantity or nature of water withdrawn requires approval/permits from regulatory agencies, the Contractor shall procure such permits at its expense and submit copies to the Engineer before commencing the work.

1.04 SUBSURFACE INFORMATION

A. A separate geotechnical report is provided for information purposes with the Contract Documents. The report identifies properties below grade and offers recommendations for foundation design, primarily for use of the Engineer. The recommendations shall not be construed as requirements of the Contract.

B. The Owner and the Engineer will not assume responsibility for variations of sub-soil quality or conditions at locations other than places shown and at the time the geotechnical investigation was made. The Contractor shall examine the site and review the available geotechnical report or undertake its own subsurface investigation prior to submitting its bid, taking into consideration all conditions that may affect its work.

1.05 GROUNDWATER

A. The Contractor shall be responsible for anticipating groundwater conditions and shall provide positive control measures as required. Such measures shall ensure stability of excavations, groundwater pressure control, prevention of tanks, pipes, and other structures from being lifted by hydrostatic pressures, and avoiding the disturbance of subgrade bearing materials.

B. The Contractor shall be responsible for obtaining all permits required for dewatering operations.

1.06 TRENCH SAFETY ACT COMPLIANCE

A. The Contractor by signing and executing the contract is, in writing, assuring that it will perform any trench excavation in accordance with the Florida Trench Safety Act, Section 553.60 et. seq. The Contractor has further identified the separate item(s) of cost of compliance with the applicable trench safety standards as well as the method of compliance and has included it in the Contract for Construction.

B. The Contractor acknowledges that this cost is included in the applicable items of the Proposal and Contract and in the Grand Total Contract Price.

C. The Contractor is, and the Owner and Engineer are not, responsible to review or assess the Contractor's safety precautions, programs or costs, or the means, methods, techniques or technique adequacy, reasonableness of cost, sequences or procedures of any safety precaution, program, or cost, including but not limited to, compliance with all requirements of Florida Statute Section 553.60 et. seq. cited as the "Trench Safety Act". The Contractor is, and the City and Engineer are not, responsible for determining if any safety or safety-related standards apply to the project, including but not limited to, the "Trench Safety Act".

1.07 PROTECTION OF PROPERTY AND STRUCTURES

A. The Contractor shall, at its own expense, sustain in place and protect from direct or indirect injury, all pipes, poles, conduits, walls, buildings, and all other structures, utilities, and property in the vicinity of its Work. Such sustaining shall be done by the Contractor. The Contractor shall take all risks attending the presence or proximity of pipes, poles, conduits, walls, buildings, and all other structures, utilities, and its Work. It shall be responsible for all damage, and assume all expenses, for direct or indirect injury and damage, caused by its Work, to any such pipe, structures, etc., or to any person or property, by reason of injury to them, whether or not such structures, etc., are shown on the Drawings.

B. Barriers shall be placed at each end of all excavations and at such places as may be necessary along excavations to warn all pedestrian and vehicular traffic of such excavations. Barricades with flashing lights shall also be placed along excavation from sunset each day to sunrise of the next day until such excavation is entirely refilled, compacted, and paved. All excavations shall be barricaded where required to meet OSHA, local and Federal Code requirements, in such a manner to prevent persons from falling or walking into any excavation within the site fenced property limits.

PART 2 – PRODUCTS

2.01 GEOTEXTILE

A. As specified in the Contract Documents.

2.02 MARKING TAPE

A. Plastic:

1. Inert polyethylene, impervious to known alkalis, acids, chemical reagents, and solvents likely to be encountered in soil.

2. Thickness: Minimum 4 mils.

3. Minimum Width: 2 inches.

4. Identifying Lettering: Minimum 1-inch high, permanent black lettering imprinted continuously over entire length.

5. Manufacturers and Products:

   a. Reef Industries; Terra Tape.

   b. Allen; Markline.

B. Metallic:

1. Solid aluminum foil, visible on unprinted side, encased in a protective high visibility, inert polyethylene plastic jacket.

2. Foil Thickness: Minimum 5.5 mils.

3. Width: 6 inches.

4. Identifying Lettering: Minimum 1-inch high, permanent black lettering imprinted continuously over entire length.

5. Joining Clips: Tin or nickel-coated furnished by tape manufacturer.

6. Manufacturers and Products:

   a. Reef Industries; Terra ”D”.

   b. Allen; Detectatape.

C. Color: In accordance with APWA Uniform Color Code for Temporary Marking of Underground Facilities.

Color[a]	**Facility**
Red	Electric power lines, cables, conduit, and lightning cables
Orange	Communicating alarm or signal lines, cables, or conduit
Yellow	Gas, oil, steam, petroleum, or gaseous materials
Green	Sewers and drain lines
Blue	Water, irrigation, and slurry lines
[a]As specified in ANSI Z53.1, Safety Color Code.	

2.03 TRENCH STABILIZATION MATERIAL

A. Foundation stabilization rock as specified in the Section 31 23 23 – Fill and Backfill.

2.04 BEDDING MATERIAL AND PIPE ZONE MATERIAL

A. Granular fill as specified in the Section 31 23 23 – Fill and Backfill.

2.05 EARTH BACKFILL

A. Earthfill as specified in the Section 31 23 23 – Fill and Backfill.

PART 3 – EXECUTION

3.01 TRENCH EXCAVATION

A. See requirements in the Section 31 23 16 - Excavation.

3.02 TRENCH PREPARATION

A. Water Control:

1. As specified in the Contract Documents.

2. Remove water in a manner that minimizes soil erosion from trench sides and bottom.

3. Provide continuous water control until trench backfill is complete.

B. Remove foreign material and backfill contaminated with foreign material that falls into trench.

C. Where the trench has been dewatered, backfilling must be done before the pumps are shut off so that the pipe will not float. Any pipe which has been displaced because of floatation will be removed and installed correctly at the Contractor’s expense.

3.03 TRENCH BOTTOM

A. Firm Subgrade: Grade with hand tools, remove loose and disturbed material, and trim off high areas and ridges left by excavating bucket teeth. Allow space for bedding material if shown or specified.

B. Soft Subgrade: If subgrade is encountered that may require removal to prevent pipe settlement, the Contractor will determine depth of over-excavation, if any, required.

3.04 TRENCH STABILIZATION MATERIAL INSTALLATION

A. Rebuild trench bottom with trench stabilization material as directed by the Engineer.

B. Place material over the full width of trench in 6-inch lifts to required grade, providing allowance for bedding thickness.

C. Compact each lift to provide a firm, unyielding support for the bedding material prior to placing succeeding lifts.

3.05 BEDDING

A. Furnish granular fill or imported bedding material as directed by the Engineer.

B. Place over the full width of the prepared trench bottom in two equal lifts when the required depth exceeds 8 inches.

C. Hand grade and compact each lift to provide a firm, unyielding surface.

D. Minimum thickness from the following depths below the bottom to the springline of the pipe are as follows, except increase depths listed by 6 inches in areas of rock excavation:

1. Pipe, 15 Inches and Smaller: 4 inches.

2. Pipe, 18 Inches to 36 Inches: 6 inches.

3. Pipe, 42 Inches and Larger: 8 inches.

4. Conduit: 3 inches.

5. Direct-Buried Cable: 3 inches.

6. Duct Banks: 3 inches.

E. Check grade and correct irregularities in bedding material. Loosen top 1 to 2 inches of compacted bedding material with a rake or by other means to provide a cushion before laying each section of pipe, conduit, direct-buried cable, or duct bank.

F. Install to form continuous and uniform support except at bell holes, if applicable, or minor disturbances resulting from removal of lifting tackle.

G. Bell or Coupling Holes: Excavate in bedding at each joint to permit proper assembly and inspection of joint and to provide uniform bearing along barrel of pipe or conduit.

3.06 BACKFILL PIPE ZONE

A. Furnish granular fill or imported bedding material as directed by the Engineer.

B. Upper Limit of Pipe Zone Shall Not Be Less Than Following:

1. Pipes:

    a. Up to 12-Inch Diameter: 6 inches above top of pipe.

    b. Greater than 12-Inch Diameter: 12 inches above top of pipe, unless shown otherwise.

2. Conduit: 3 inches, unless shown otherwise.

3. Direct-Buried Cable: 3 inches, unless shown otherwise.

4. Duct Bank: 3 inches, unless shown otherwise.

C. Restrain pipe, conduit, cables, and duct banks as necessary to prevent their movement during backfill operations.

D. Place material simultaneously in lifts on both sides of pipe and, if applicable, between pipes, conduit, cables, and duct banks installed in same trench. Compact to 90 percent density as determined by AASHTO T99.

1. Pipes 10 Inches and Smaller Diameter: First lift less than or equal to 1/2 pipe diameter but not less than 3 inches.

2. Pipes Over 10-Inch Diameter: Maximum 6-inch lifts.

E. Thoroughly tamp each lift, including area under haunches, with handheld tamping bars supplemented by “walking in” and slicing material under haunches with a shovel to ensure that voids are completely filled before placing each succeeding lift. Compact material in pipe zone to at least 98 percent maximum density as determined by AASHTO T180.

F. After the full depth of the pipe zone material has been placed as specified, compact the material by a minimum of three passes with a vibratory plate compactor only over the area between the sides of the pipe and the trench walls. Contractor shall exercise proper care to ensure that no pipe joints will be broken, damaged, or disturbed using compacting equipment.

G. Do not use power-driven impact compactors to compact pipe zone material.

H. Where approved by the Owner, hydraulic compaction of the pipe zone material and granular trench backfill may be used providing density testing requirements are met. A submittal describing the method of hydraulic compaction will be required.

3.07 MARKING TAPE INSTALLATION

A. Continuously install marking tape along centerline of all buried piping, on top of last lift of pipe zone material. Coordinate with piping installation drawings.

1. Metallic Marking Tape: Install with nonmetallic piping and waterlines.

2. Plastic Marking Tape: Install with metallic piping.

3.08 BACKFILL ABOVE PIPE ZONE

A. General:

1. Process excavated material to meet specified gradation requirements.

2. Adjust moisture content as necessary to obtain specified compaction.

3. Do not allow backfill to free fall into the trench or allow heavy, sharp pieces of material to be placed as backfill until after at least 2 feet of backfill has been provided over the top of pipe.

4. Do not use power driven impact type compactors for compaction until at least 4 feet of backfill is placed over top of pipe.

5. Backfill to grade with proper allowances for topsoil, crushed rock surfacing, and pavement thicknesses, wherever applicable.

6. Backfill around structures with same class backfill as specified for adjacent trench unless otherwise shown or specified.

7. Hydraulic compaction may be allowed based upon approval by the Owner of the Contractor's detailed compaction and testing procedures.

B. Backfill for Areas in Landscaped Areas:

1. Place in lifts not exceeding 12-inch thickness.

2. Mechanically compact each lift to a minimum of 80 percent of the maximum density prior to placing succeeding lifts.

C. Backfill for Areas under Facilities and Pavements: Backfill trench above the pipe zone with granular backfill in lifts not exceeding 12 inches. Compact each lift to a minimum of 98 percent of the maximum density compaction as determined by AASHTO Method T180, 100% for Broward County Rights of Way, prior to placing succeeding lifts.

3.09 ALTERNATE METHOD OF CONSTRUCTION

A. When high water tables, porous soils or other limitations to dewatering are encountered, the Contractor may request the approval of the Owner for an alternate method of construction.

B. Use of alternative methods shall not relieve the Contractor of the work, result in increased costs to the Owner or reductions in the quality of the work as defined by testing and acceptance requirements.

C. Removal of water requirements will be waived and the pipe and appurtenances will be permitted to be installed underwater.

D. Excavation shall be performed in accordance with the Contract Documents to the specified limits. The excavation shall be cleared of silt and other fines.

E. Pipe bedding shall be placed from the bottom of the excavation to 6 inches above the top of the pipe. The bedding shall be granular fill as described in the Contract Documents.

F. Select backfill material shall be used to backfill the trench from the top of the bedding to a level 1 foot above the standing water level in the trench. Select material shall be FDOT # 57 stone or granular fill as described in the Contract Documents. This lift shall be compacted in accordance with the provisions of this Section after which the remainder of the backfill can proceed as normal.

G. If the above-described method is used, all backfill material used below the water table shall not be released into the trench until the bucket or container is less than 1 foot above the water level. Pipe bedding and pipe zone material as defined above shall not be dumped or pushed into the trench.

3.10 MAINTENANCE OF TRENCH BACKFILL

A. After each section of trench is backfilled, maintain the surface of the backfilled trench even with the adjacent ground surface until final surface restoration is completed.

B. Other Areas: Add excavated material where applicable and keep the surface of the backfilled trench level with the adjacent ground surface.

C. Water shall be applied to the unstabilized trench backfill to control dust as directed by the Engineer.

D. Placement of lime rock base course and prime coat shall occur no longer than 5 days following trench backfill or as soon thereafter as record information is available to verify that pipe inverts and slopes are acceptable.

3.11 SETTLEMENT OF BACKFILL

A. Settlement of trench backfill or of fill or facilities constructed over trench backfill within the warranty period for the project will be considered a result of defective compaction of trench backfill.

END OF SECTION

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SECTION 31 25 00
EROSION AND SEDIMENTATION CONTROL

PART 1 – GENERAL

1.01 THE REQUIREMENTS

A. The Contractor shall furnish all material, labor and equipment necessary for the proper installation, maintenance, inspection, monitoring, reporting, and removal (where applicable) of erosion prevention and sediment control measures.

B. The Contractor shall obtain all necessary permits including the Florida Department of Environmental Protection (FDEP) – National Pollutant Discharge Elimination System (NPDES) stormwater program for construction activities.

C. If required by the authority having jurisdiction, the Contractor shall create a Stormwater Pollution Prevention Plan (SWPPP) for regulatory approval and enforcing its requirements in accordance with applicable Federal, State, and local regulations. The complete SWPPP shall be submitted by the Contractor and approved by the regulatory agencies having jurisdiction before the start of construction.

D. Temporary erosion and sedimentation controls may include those described in the references and shown on the Drawings.

1.02 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. “Guidelines for Erosion and Sediment Control, Planning and Implementation” published by the United States Environmental Protection Agency.

B. “Processes, Procedures and Methods to Control Pollution Resulting from all Construction Activity”, published by the United States Environmental Protection Agency.

C. “The Florida Stormwater, Erosion, and Sedimentation Control Inspector’s Manual” published by the Florida Department of Environmental Protection.

D. “Erosion and Sediment Control Designer and Review Manual” (ESCDRM) published by the Florida Department of Transportation and FDEP.

E. Florida NPDES Stormwater Program: https://floridadep.gov/Water/Stormwater

1.03 SUBMITTALS

A. Contractor shall provide a copy of all permit applications, approvals, and reporting documentation submitted to permitting agencies.

B. Submittals shall comply with the requirements specified in the section titled “Submittal Procedures”.

1.04 QUALITY ASSURANCE

A. Operations restricted to areas of work indicated on drawings and area which must be entered for construction of temporary or permanent facilities.

B. Engineer has authority to limit surface area of erodible earth material exposed by clearing and grubbing, excavation, borrow and fill operations and to direct immediate permanent or temporary pollution control measures to prevent contamination of any stream or wetlands, including construction of temporary berms, dikes, dams, sediment basins, sediment traps, slope drains, and use of temporary mulches, mats, or other control devices or methods as necessary to control erosion.

PART 2 – PRODUCTS

2.01 MATERIALS

A. All products shall comply with best industry practices.

B. Comply with the requirements shown on Drawings and approved SWPPP.

PART 3 – EXECUTION

3.01 DESIGN

A. Design of erosion and sedimentation control measures shall comply with the requirements in the ESCDRM.

3.02 GENERAL

A. Prior to the start of work, provide and install erosion and sedimentation control as indicated on the Drawings and the Contractor prepared SWPPP and as required by applicable regulations. Maintain such system for the duration of the project.

B. Should any of the temporary erosion and sedimentation control measures employed by the Contractor fail to produce results that comply with the requirements of the authority having jurisdiction, Contractor shall immediately take all necessary steps to correct the deficiency at its own expense.

3.03 ADDITIONAL REQUIREMENTS

A. Construct earth berms or diversions to intercept and divert runoff water from critical areas.

B. Discharge silt-laden water from excavations onto filter fabric mat and/or baled hay or straw sediment traps to ensure that only sediment-free water is returned to watercourses.

C. Do not place excavated soil material adjacent to watercourse in manner that will cause it to wash away by high water or runoff.

D. Prevent damage to vegetation by excessive watering or silt accumulation in the discharge area.

E. Do not dump soiled material into any streams, wetlands, surface waters, or unspecified locations.

F. Do not pump silt-laden water from trenches or excavations into surface waters, streams, wetlands, or natural or man-made channels leading thereto.

G. Prevent damage to vegetation adjacent to or outside of construction area limits.

H. Do not dispose of trees, brush, debris, paints, chemicals, asphalt products, concrete curing compounds, fuels, lubricants, insecticides, washwater from concrete trucks or hydroseeders, or any other pollutant in streams, wetlands, surface waters, or natural or man-made channels leading thereto, or unspecified locations.

I. Do not alter flow line of any stream unless indicated or specified.

J. All exposed graded, cleared, filled, etc. land to remain shall be stabilized with sod, filter fabric, and/or vegetation acceptable to the Owner.

END OF SECTION

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DIVISION 32 – EXTERIOR IMPROVEMENTS

SECTION 32 11 00
SURFACE RESTORATION

PART 1 – GENERAL

1.01 STANDARD SPECIFICATIONS

A. When referenced in this Section, Standard Specifications shall mean Florida Department of Transportation, Standard Specifications for Road and Bridge Construction, current edition.

1.02 INTENT

A. Specific surface restoration requirements are detailed in this and other sections.

B. For this Temporary Sodium Hypochlorite System project, the intent of these Specifications and the criteria of the Measurement and Payment Section is that the existing onsite plant roadways, sidewalk, and curb and gutter affected by construction activity shall be returned to their pre-existing condition, or modified as otherwise indicated on the Drawing and by these Contract Documents.

C. For work areas disturbed by the Contractor for convenience, the area affected shall be restored in kind.

1. The costs of this restoration shall be incidental to the cost of the Work.

2. Payment for restoration outside the limits of work shall be repaired at the Contractor's expense.

1.03 WORK INCLUDED

A. This Section covers the Work necessary to replace all pavement, pavers, curbs, sidewalks, rock surfacing, vegetation, and other site improvement features damaged either directly or indirectly by the operations incidental to the construction described in other sections of the Contract Documents.

B. Where the materials, construction procedures, degree of compaction of materials, and the method of control and testing, as required in the Contract Documents differ from the Standard Specifications requirements, the more stringent requirements shall apply.

C. The intent of the Drawings is to provide permanent trench repair for all work crossing or running parallel with roadways. Temporary restoration to provide a passable surface will be required to maintain Owner access to onsite facilities.

D. Overlay of asphalt pavement may be required where shown on the Drawings.

E. Replace curb and gutter where impacted by construction activity and as shown on the Drawings.

F. Replace sidewalks where impacted by construction activity and as shown on the Drawings.

G. Provide finished gradation and grassing in accordance with the Contract Documents.

1.04 OPTIMUM MOISTURE CONTENT

A. "Optimum moisture content" shall be determined by the ASTM standard specified to determine the maximum dry density for relative compaction.

1.05 TEMPORARY TRENCH REPAIR OR STABILIZATION

A. Following pipe installation and prior to permanent trench repair or asphalt replacement, temporary trench repair will be defined as one of the following:

1. Installation of flowable fill as described in this Section and the Contract Documents.

2. Installation of the compacted base course and an asphalt prime coat as described in this Section and the Contract Documents.

B. Temporary trench repair shall be maintained in accordance with the requirements of this Section and the Contract Documents until the final trench repair or asphalt surface is installed to provide a dust-free, drivable, and safe roadway surface.

1.06 STANDARDS

A. AASHTO T180: Standard Method of Test for Moisture–Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop

B. ASTM A615: Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

C. FM 5-509: Florida Method of Test for Measurement of Pavement Smoothness With the 15-Foot Rolling and Manual Straightedges

PART 2 – MATERIALS

2.01 GENERAL

A. All materials for replacement of existing base course and asphalt surfacing shall conform to the Standard Specifications except as modified herein.

B. The Contractor will be responsible for furnishing satisfactory materials that meet the specifications of the Contract Documents and shall provide such tests during the course

of the Work as are necessary to assure that the quality of the material used meets the specifications of the Contract Documents.

2.02 LIME ROCK BASE COURSE

A. Aggregate quality and gradation shall meet the requirements of the Standard Specifications.

2.03 BITUMINOUS PRIME AND TACK COAT

A. Prime Coat: Material shall be cutback asphalt, Grade RC-70 or RC-250 meeting the requirements of the Standard Specifications, or approved equal.

B. Tack Coat: Material shall be emulsified asphalt, Grade RS-2, SS-1, or SS-1H meeting the requirements of the Standard Specifications.

C. Tack coats used for temporary trench stabilization shall be sanded to prevent damage to vehicles.

2.04 ASPHALT CONCRETE

A. The asphalt concrete for trench leveling, restoration and overlay shall be Type SP-9.5, meeting the requirements of the Standard Specifications and the Contract Documents.

B. Aggregate: The aggregate shall meet the requirements of the Standard Specifications.

C. Submit test results from commercial testing laboratories to the City to show that the materials meet the quality and gradation requirements.

2.05 FLOWABLE FILL

A. Provide flowable fill with a mix design meeting the requirements of the (FDOT) Standard Specifications and Section 31 23 24 of these specifications for excavatable, flowable fill. Flowable fill may be allowed as a substitute for compacted base upon approval of the Engineer, at no additional cost.

2.06 CONCRETE

A. Concrete shall be 3,000 psi minimum concrete meeting the requirements of the Standard Specifications.

B. Concrete Forms: All forms for curbs and sidewalks shall be either 2-inch dimensioned lumber, plywood, or metal forms. Forms on the face of the curb shall have no horizontal form joints within 7 inches of the top of the curb.

C. Curing Compound: Meeting the requirements of the Standard Specifications.

D. Reinforcing Steel: Conform to ASTM A615, Grade 60.

2.07 TRAFFIC MARKINGS

A. All traffic striping markings (i.e., lane, edge of pavement, directional, informational, etc.) damaged by the Contractor during construction shall be replaced with new markings meeting the requirements of the Broward County Traffic Engineering Division and the Standard Specifications.

B. Raised reflective pavement markers (rpm's) damaged by the Contractor during construction shall be replaced with new rpm's meeting the requirements of the Broward County Traffic Engineering Division and the Standard Specifications.

C. The Contractor shall place and maintain temporary striping markings throughout the course of the work until the permanent striping marking is placed on the final roadway surface.

D. The Contractor shall provide traffic stripping at all intersections including stop bars and crosswalks as required whether they are currently stripped or not. It shall be the Contractor's responsibility to take a complete inventory and provide the appropriate permanent stripping after the completion of the Work.

2.08 SWALE STABILIZATION

A. Materials used for stabilization of swale areas as indicated on the Drawings shall consist of suitable excess existing base material removed from trenching operations, if approved by the Engineer, crushed limerock, rock screenings, or other suitable material as approved by the Engineer.

1. Materials having a plasticity index of more than 10, or a liquid limit greater than 40 shall not be used.

2. Maximum dimension shall not exceed 1.5 inches.

PART 3 – EXECUTION

3.01 CONSTRUCTION PROCEDURE

A. The City reserves the right to vary the type of resurfacing as best serves the interest of the Owner. Trench backfill shall be as specified in the Contract Documents.

B. Replace all bituminous and concrete roadway pavement damaged or removed under this Contract with asphalt concrete regardless of original type. Pavement thickness shall be in accordance with the Drawings.

C. In addition to the requirements set forth herein, the work shall conform to the applicable workmanship requirements of the state and county highway or municipal specifications.

D. Water to control dust shall be used as directed by the City until the trench repair has been stabilized. If control of dust is inadequate by these means, the City may direct the immediate application of a prime or tack coat in accordance with the provisions of this Section, at no additional cost to the Owner. The City reserves the right to delay additional excavation activities until dust control measures are adequate.

E. Base course and prime coat shall be installed to provide temporary trench stabilization within 5 working days of trench backfill.

F. Final, permanent trench repair, and paving shall be installed within 3 weeks of pipe verification and temporary trench stabilization, unless flowable fill is used for temporary trench repair, in accordance with the provisions of this Section.

3.02 REMOVAL OF PAVEMENT, SIDEWALK, CURBS, AND GUTTERS

A. Removal of all pavement, sidewalks, curbs, and gutters shall conform to the Contract Documents, and payment for removal shall be included in that Section of the Contract Documents. Payment for removal is incidental to the cost of pipe installation except where required for water and sewer service installation.

3.03 CUTTING EXISTING PAVEMENT

A. Where new pavement abuts existing pavement, the old pavement shall be trimmed by saw cutting to a straight line. Any pavement which has been damaged or which is broken and unsound shall be removed to provide a smooth, sound edge for joining new pavement.

3.04 ROADWAY MAINTENANCE

A. Maintain all trenches as specified in this section and the Contract Documents.

3.05 CONSTRUCTION OF BASE COURSE

A. Base course shall be constructed in accordance with the City of Hollywood Standards and the Standard Specifications.

B. Compact base materials to a minimum of 98 percent of the maximum density as determined by AASHTO T180. Corrections for oversize material may be applied to either the as-compacted field dry density or the maximum dry density, as determined by the Engineer. Where the base is constructed in more than one course, the density shall be obtained in each lift.

C. Alternately, and with the approval of the Engineer, the Contractor shall provide a minimum 10 inches of excavatable, flowable fill. The flowable fill shall be placed up to 1 ½ inches from the top of the existing pavement or to the fill line without vibration or compaction. Flowable fill shall not be placed during periods of inclement weather and rainfall. Provide a means to confine the material within the designated space. Flowable fill installed in

accordance with this provision shall comply with temporary pavement restoration provisions.

3.06 MILLING OR GRINDING OF EXISTING ASPHALT PAVEMENT

A. Milling of existing asphalt pavement shall meet the requirements of the Standard Specifications.

B. Milling shall be used to lower the grade of adjacent existing asphalt prior to trench repair to completely remove existing asphalt.

C. Milled and ground asphalt can be mixed for use with the limerock base course material.

3.07 BITUMINOUS PRIME AND TACK COAT

A. The bituminous prime coat shall be applied to the lime rock base immediately following the placement of the compacted base course. The prime coat shall be maintained with additional coats as determined by the City as temporary restoration until the final asphalt surface is installed. Additional prime coats will be provided at no cost to the Owner.

B. The lime rock base shall be hard planed with a blade grader immediately prior to the application of the prime coat.

C. The rate of application of the bituminous prime coat shall meet the requirements of the Standard Specifications.

D. The bituminous tack coat shall be applied to existing asphalt surfaces prior to the placement of new asphalt, between layers of asphalt concrete surface courses, surfaces of concrete footings that will come in contact with the asphalt concrete pavement, and vertical faces of all longitudinal and transverse joints that have become compacted or cooled.

E. The rate of application for the bituminous tack coat shall meet the requirements of the Standard Specifications.

3.08 ASPHALT CONCRETE PAVEMENT REPLACEMENT

A. Preparation for Paving:

1. A prime coat shall be applied over the full length of the roadway, and asphalt concrete pavement shall not be placed until the prime coat has cured as per the manufacturer's recommendations.

2. Should any holes, breaks, or irregularities develop in the roadway surface after the prime coat has been applied, they shall be patched with asphalt concrete immediately in advance of placing the asphalt concrete.

3. After the maintenance, patching, or repair work has been completed and immediately prior to placing the asphalt concrete pavement, the surface of the prime coat shall be swept clean of all dirt, dust, or other foreign matter.

B. The proposed pavement reconstruction schedule consists of immediately paving over trenches as soon as possible after it has been determined that subbase and base have achieved required compactions. The base course will be brought up to the elevations indicated on the Drawings and asphalt placed to bring grade up to match existing pavement elevations as shown on the Drawings.

3.09 CONSTRUCTION OF ASPHALT CONCRETE PAVEMENT OVERLAY – IF REQUIRED

A. The Contractor shall place a layer of tack coat at a rate of 0.05 to 0.12 gallon per square yard over all areas to receive asphalt concrete.

B. Lay asphalt concrete over all areas designated to be resurfaced. The asphalt concrete pavement overlay shall be placed in minimum 1-inch lift and maximum lift as shown in the Contract Documents. The method of proportioning, mixing, transporting, laying, processing, rolling the material, and the standards of workmanship shall meet the applicable requirements of the Standard Specifications. At no time shall the coarse aggregate segregated from the mix either from hand spreading or raking of joints be scattered across the paved mat. Such material shall be collected and disposed of.

C. The City will examine the prepared roadway before the paving is begun and bring any deficiencies to the Contractor's attention to be corrected before the paving is started. Roll each lift of the asphalt concrete until roller marks are eliminated and compacted to 100 percent of the laboratory compacted mixture. The grade, line, and cross section of the finished surface shall conform to the Drawings. Asphalt or asphalt stains which are noticeable upon surfaces of concrete or materials which will be exposed to view shall be promptly and completely removed.

3.10 ASPHALT CONCRETE PAVEMENT

A. Workmanship in producing, hauling, placing, compacting, and finishing asphalt concrete shall meet the applicable portions of the Standard Specifications.

3.11 CONNECTIONS WITH EXISTING FACILITIES

A. Where the bituminous pavement is to be connected with an existing roadway surface or other facility, the Contractor will be required to modify the existing roadway profile in such a manner as to produce a smooth connection to the existing facility. The Contractor shall meet existing neat lines where required.

B. Where it is necessary to remove existing asphalt surfaces or oil mat surfaces to provide proper meet lines and riding surfaces, the Contractor shall sawcut the existing surface so that there will be sufficient depth to provide a minimum of 1-inch of asphalt concrete, and the waste material shall be disposed of to the satisfaction of the Engineer. Prior to placing

the asphalt concrete, these areas shall be tacked. Meet lines shall be straight and the edges vertical. The edges of meet line cuts shall be painted with liquid asphalt or emulsified asphalt prior to placing asphalt concrete. After placing the asphalt concrete, the meet line shall be sealed by painting with a liquid asphalt or emulsified asphalt and immediately covered with clean, dry sand.

3.12 CONSTRUCTION OF COURSES

A. The asphalt concrete pavement shall be constructed in one or more courses as shown on the Drawings.

B. Rolling shall continue until all roller marks are eliminated and compacted to 100 percent of the laboratory compacted mixture has been obtained.

3.13 SURFACE TOLERANCE

A. Tests for conformity with the specified grade shall be made by the Contractor immediately after initial compression. Any variation shall be immediately corrected by the removal or addition of materials and by continuous rolling.

B. The completed surface of the pavement shall be of uniform texture, smooth, uniform as to grade, and free from defects of all kinds. The completed surface shall not vary more than 1/8 inch from the lower edge of a 12-foot straightedge placed on the surface along the centerline or across the trench.

C. After completion of the final rolling, the smoothness and grade of the surface shall again be tested by the Contractor.

D. When deviations in excess of the above tolerances are found, the pavement surface shall be corrected as stated in the Standard Specifications.

E. All areas in which the surface of the completed pavement deviates more than twice the allowable tolerances described above shall be removed and replaced to the satisfaction of the Engineer.

F. All costs involved in making the corrections of defects described above shall be borne by the Contractor and no compensation will be made for this Work.

G. For all State of Florida jurisdictions roads, and other jurisdiction roads when required by the permit, test pavement smoothness via FM 5-509.

3.14 SAMPLES

A. If directed by the Engineer, the Contractor shall without additional charge, provide the City with test results of samples of asphalt concrete cut from the completed pavement or the individual courses thereof for each occurrence. Provide a minimum of three test cores located as directed by the Engineer. He shall also provide the City with test results of samples of the uncompressed asphalt concrete mixtures and all materials incorporated in the Work.

3.15 WEATHER CONDITIONS

A. Asphalt shall not be applied to wet material. Asphalt shall not be applied during rainfall or any imminent storms that might adversely affect the construction. The City will determine when surfaces and materials are dry enough to proceed with construction. Asphalt concrete shall not be placed during heavy rainfall or when the surface upon which it is to be placed is wet.

3.16 PROTECTION OF STRUCTURES AND ADJUSTMENT OF APPURTENANCES

A. Provide whatever protective coverings may be necessary to protect the exposed portions of bridges, culverts, curbs, gutters, posts, guard fences, road signs, and any other structures from splashing oil and asphalt from the paving operations. Remove any oil, asphalt, dirt, or any other undesirable matter that may come upon these structures by reason of the paving operations.

B. Where water valve boxes, manholes, catch basins, or other underground utility appurtenances are within the area to be surfaced, the Contractor shall adjust the tops of these facilities to conform with the proposed surface elevations. The Contractor shall notify the proper authority and either raise or lower the appurtenances or make arrangements with that authority for having the facilities altered at the Contractor's expense before proceeding with the resurfacing. The Contractor will be responsible for making certain that appurtenances are brought to proper grade to conform with finished surface elevations and any delays experienced from such obstructions will be considered as incidental to the paving operation. No additional payment will be made. Protect all covers during asphalt application. All adjustments shall be made in accordance with the requirements of the respective utility.

C. To extend manhole use grade rings as specified, do not use leveling rings. Remove the frame and cover, rebuild the manhole top to raise it so that the new height meets the overlay elevations and then replace the frame and cover in accordance with the Contract Documents.

3.17 EXCESS MATERIALS

A. Legally dispose of all excess materials. Make arrangements for the disposal and bear all costs or retain any profit incidental to such disposal.

3.18 CONTRACTOR'S RESPONSIBILITY

A. Settlement of replaced pavement over trenches within the warranty period shall be considered the result of improper or inadequate compaction of the subbase or base materials. The Contractor shall promptly repair all pavement deficiencies noted during the warranty period at the Contractor's sole expense.

3.19 SIDEWALKS AND CURBS

A. Replace concrete sidewalks and curbs to the same section width, depth, line, and grade as that removed or damaged or as shown on the Drawings. The minimum thickness of sidewalks shall be 6 inches. Cut ends of existing curb to a vertical plane. Prior to replacing the sections, properly backfill and compact the trench to prevent subsequent settlement.

B. Replace concrete sidewalks at scored joints and make replacement in a manner that will avoid a patched appearance. Provide a minimum 2-inch thick compacted leveling course of clean sand or gravel of quality hereinbefore specified. Finish concrete surface similar to the adjacent sidewalks. All curbs and all gutters shall have a minimum of 4” LBR 100 limerock “curb pad”.

3.20 DRIVEWAYS AND WALKS

A. Replace asphalt driveways and walks in accordance with Paragraph Asphalt Concrete Pavement Replacement.

B. Replace concrete and paver driveways in kind, using similar materials of construction. Concrete driveways shall consist of a reinforced, 6-inch section installed in accordance with the Contract Documents.

3.21 TRAFFIC STRIPES

A. All areas having traffic stripes prior to paving shall be restriped. Temporary traffic striping shall be applied immediately after asphalt pavement has been placed. Permanent traffic striping may be applied only after the proper curing time for the asphalt. Traffic stripes (temporary and permanent) shall meet the requirements of Broward County Traffic Engineering Division Standards and the Standard Specifications.

3.22 INSTALLATION OF RAISED REFLECTIVE PAVEMENT MARKERS

A. All areas having raised reflective pavement markers prior to paving shall have those markers replaced. Temporary pavement markers shall be applied immediately after asphalt pavement has been placed. Permanent pavement markers may be applied only after the proper curing time for the asphalt. Pavement markers and adhesive (temporary and permanent) shall meet the requirements of Broward County Traffic Engineering Division and the Standard Specifications.

B. Spacing: As shown in the Roadway and Traffic Design Standards for Design, Construction, Maintenance and Utility operations on the State Highway System by the State of Florida, Department of Transportation, current edition and the Broward County Traffic Engineering Division Standards.

3.23 PAVEMENT REPAIR

A. All damage to pavement as a result of work under this Contract shall be repaired in a manner satisfactory to the City and at no additional cost to the Owner. The repair shall include preparation of the subgrade, placing and compaction of the lime rock base and placement of the final asphalt surface as described in this Section.

B. The width of all repairs shall extend at least 12 inches beyond the limit of the damage with the edge of pavement left saw cut to a true edge with no irregularities.

END OF SECTION

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SECTION 32 12 00
ASPHALT CONCRETE PAVEMENT

PART 1 – GENERAL

1.01 STANDARD SPECIFICATIONS

A. When referenced in this section, Standard Specifications shall mean Florida Department of Transportation, Standard Specifications for Road and Bridge Construction, current edition.

1.02 QUALITY ASSURANCE

A. Qualifications:

1. Independent Testing Laboratory: In accordance with ASTM E329.

2. Asphalt concrete mix formula shall be prepared by an approved certified independent laboratory under the supervision of a certified asphalt technician.

1.03 SUBMITTALS

A. The Contractor shall submit its proposed formula for the asphaltic concrete paving for review in accordance with the Section entitled “Submittal Procedures”.

1.04 ENVIRONMENTAL REQUIREMENTS

A. Temperature: Do not apply asphalt materials or place asphalt mixes when ground temperature is lower than 10 degrees C (50 degrees F), or air temperature is lower than 4 degrees C (40 degrees F). Measure ground and air temperature in shaded areas away from heat sources or wet surfaces.

B. Moisture: Do not apply asphalt materials or place asphalt mixes when application surface is wet.

PART 2 – MATERIALS

2.01 MATERIALS

A. Prime Coat: Cut-back asphalt, Grades RC-70 or RC-250 meeting the requirements of the Standard Specifications.

B. Tack Coat: Emulsified asphalt, Grade RS-2, SS-1, or SS-1H meeting the requirements of the Standard Specifications. The bituminous material shall be heated to a suitable consistency as directed by the City.

C. Sand (Blotter Material): Clean, dry, with 100 percent passing a 4.75 mm (No. 4) sieve, and a maximum of 10 percent passing a 75 mm (No. 200) sieve.

2.02 ASPHALT CONCRETE MIX

A. Asphalt Concrete: Type S-3 or Type SP meeting the requirements of the Standard Specifications.

B. Composition: Hot-plant mix of aggregate, mineral filler, and performance graded asphalt binder. The several aggregate fractions shall be sized, uniformly graded, and combined in such proportions that the resulting mixture meets the grading requirements of the mix formula.

C. Aggregate:

1. The aggregate shall meet the requirements of the Standard Specifications.

2. Mineral Filler shall meet the requirements of the Standard Specifications

D. Asphalt Binder: Performance Grade PG 76-22 meeting the requirements of the Standard Specifications.

PART 3 – EXECUTION

3.01 GENERAL

A. Traffic Control: Minimize inconvenience to traffic but keep vehicles off freshly treated or paved surfaces to avoid pickup and tracking of asphalt.

B. Driveways: Repave driveways from which pavement was removed. Leave driveways in as good or better condition than before start of construction.

3.02 LINE AND GRADE

A. Provide and maintain intermediate control of line and grade, independent of the underlying base to meet finish surface grades and minimum thickness.

B. Shoulders: Construct to line, grade, and cross-section shown.

3.03 PREPARATION

A. Prepare subgrade as specified in the Contract Documents.

B. Existing Roadway:

1. Modify profile by grinding, milling, or overlay methods as approved, to provide meet lines and surfaces and to produce a smooth riding connection to existing facility.

2. Resurface entire roadway following adjustment of base and asphalt grades.

3. Paint edges of meet line with tack coat prior to placing new pavement.

C. Thoroughly coat edges of contact surfaces (curbs, manhole frames) with emulsified asphalt or asphalt cement prior to laying new pavement. Prevent staining of adjacent surfaces.

3.04 PAVEMENT APPLICATION

A. General: Place asphalt concrete mixture on an approved, prepared base in conformance with this Section.

B. Cold Milling

1. Milling of existing asphalt pavement shall be at the depth and location as indicated on the Construction Drawings or as directed by the City.

2. The milled surface shall be reasonably smooth and free of excessive scarification marks, gouges, ridges, continuous grooves, or other damage. The milled pavement surface shall be thoroughly cleaned to the satisfaction of the Engineer of all loose aggregate particles, dust, and other objectionable material using power brooms, power blowers, power vacuums or other means.

3. The Contractor shall coordinate the adjustment of maintenance access structures, meter boxes, drainage inlets, and valve boxes with the milling operation.

4. All milled material shall become the property of the Contractor and shall be legally disposed of off-site or used in conformance with the Contract Documents, or for utilization as Reclaimed Asphalt Pavement, in conformance with the specification provided above, as approved by the City.

C. Prime Coat:

1. Heat cut-back asphalt between 100 degrees F and 150 degrees F prior to application.

2. Apply uniformly to clean, dry surfaces. Avoiding overlapping of applications.

3. Do not apply when moisture content of upper 3 inches of base exceeds optimum moisture content of base, or if free moisture is present.

4. Application Rate: Minimum 0.1 gallons per square yard of surface area.

5. Remove or redistribute excess material.

6. Allow a minimum of 5 full days for curing of primed surface before placing asphalt concrete.

D. Tack Coat:

1. Apply uniformly to clean, dry surfaces as approved by the Engineer. Avoiding overlapping of applications.

2. Do not apply more tack coat than necessary for the day's paving operation.

3. Touch up missed or lightly coated surfaces and remove excess material.

4. Application Rate:

    a. Minimum 0.05 gallons to maximum 0.12 gallons of asphalt (residual if diluted emulsified asphalt) per square yard of surface area.

    b. Apply at rate, within range specified, sufficient to assure good bonding, but not so heavy that surplus asphalt flushes into asphalt concrete being placed.

E. Pavement Mix:

1. Prior to Paving:

    a. Sweep primed surface free of dirt, dust, or other foreign matter to the satisfaction of the Engineer.

    b. Patch holes in primed surface with asphalt concrete pavement mix.

    c. Blot excess prime material with sand.

2. Place asphalt concrete pavement mix in lifts as shown.

3. Compacted Lift Thickness:

    a. Minimum: Twice the maximum aggregate size, but in no case less than 1 inch. Minimum thickness for Type SP-9.5 is 1.0 inches.

    b. Maximum: 4 inches.

4. Total Compacted Thickness: Per Contract Documents.

5. Apply such that meet lines are straight and edges are vertical.

6. Collect and dispose of segregated aggregate from raking process. Do not scatter material over finished surface.

7. Joints:

    a. Offset edge of each layer a minimum of 6 inches so joints are not directly over those in underlying layer.

    b. Offset longitudinal joints in roadway pavements, so longitudinal joints in wearing layer coincide with pavement centerlines and lane divider lines.

c. Form transverse joints by cutting back on previous day's run to expose full vertical depth of layer.

8. Succeeding Lifts: Apply tack coat to pavement surface between each lift.

9. After placement of pavement, seal meet line by painting a minimum of 6 inches on each side of the joint with cut-back or emulsified asphalt. Cover immediately with sand.

F. Compaction:

1. Roll until roller marks are eliminated and compacted to 100 percent of the laboratory compacted mixture.

2. Joint Compaction:

a. Place top or wearing layer as continuously as possible.

b. Pass roller over unprotected end of freshly laid mixture only when placing of mix is discontinued long enough to permit mixture to become chilled.

c. Cut back previously compacted mixture when Work is resumed to produce a slightly beveled edge for full thickness of layer.

d. Cut away waste material and lay new mix against fresh cut.

G. Tolerances:

General: Conduct measurements for conformity with crown and grade immediately after initial compression. Correct variations immediately by removal or addition of materials and by continuous rolling.

1. Completed Surface or Wearing Layer Smoothness:

a. Uniform texture, smooth, and uniform to crown and grade.

b. Maximum Deviation: 1/8 inch from lower edge of a 12-foot straightedge, measured continuously parallel and at right angle to centerline.

c. If surface of completed pavement deviates by more than twice the specified tolerances, remove and replace wearing surface.

2. Transverse Slope Maximum Deviation: ¼ inch in 12 feet from the rate of slope shown.

3. Finished Grade:

a. Perform a field differential level survey on a maximum 50-foot grid and along all grade breaks.

b. Maximum Deviation: 0.02 foot from the grade shown.

H. Seal Coat:

1. General: Apply seal coat of paving grade or emulsified asphalt to finished surface at longitudinal and transverse joints, joints at abutting pavements, areas where the asphalt concrete was placed by hand, patched surfaces, and other areas as directed by the City.

2. Preparation:

a. Maintain surfaces that are to be sealed free of holes, dry, and clean of dust and loose material.

b. Seal in dry weather and when the temperature is above 35 degrees F.

3. Application:

a. Fill cracks over 1/16 inch in width with an asphalt-sand slurry or approved crack sealer prior to sealing.

b. When sealing patched surfaces and joints with existing pavements, extend minimum 6 inches beyond edges of patches.

3.05 PAVEMENT OVERLAY

A. Preparation:

1. Remove fatty asphalt, grease drippings, dust, and other deleterious matter.

2. Surface Depressions: Fill with asphalt concrete mix, and thoroughly compact.

3. Damaged Areas: Remove broken or deteriorated asphalt concrete and patch as specified in Article Patching.

4. Portland Cement Concrete Joints: Remove joint filler to minimum 1/2 inch below surface.

B. Application:

1. Tack Coat: As specified in this Section.

2. Place and compact asphalt concrete as specified in Article Pavement Application.

3. Place first layer to include widening of pavement and leveling of irregularities in the surface of the existing pavement.

4. When leveling irregular surfaces and raising low areas, the actual compacted thickness of any one lift shall not exceed 2 inches.

5. The actual compacted thickness of intermittent areas of 120 square yards or less may exceed 2 inches, but not 4 inches.

6. Final wearing layer shall be of uniform thickness, and meet grade and cross-section as shown.

3.06 PATCHING HOT MIX ASPHALT

A. Preparation:

1. Remove damaged, broken, or unsound asphalt concrete adjacent to patches. Trim to straight lines exposing smooth, sound, vertical edges to the satisfaction of the Engineer.

2. Prepare patch subgrade as specified in the Contract Documents.

B. Application:

1. Patch Thickness: 3 inches or thickness of adjacent asphalt concrete, whichever is greater.

2. Place asphalt concrete mix across full width of patch in layers of equal thickness.

3. Spread and grade asphalt concrete with hand tools or mechanical spreader, depending on size of area to be patched.

C. Compaction:

1. Roll patches with power rollers capable of providing compression of 200 to 300 pounds per linear inch. Use hand tampers where rolling is impractical.

2. Begin rolling top course at edges of patches, lapping adjacent asphalt surface at least 1/2 the roller width. Progress toward center of patch overlapping each preceding track by at least 1/2 the width of roller.

3. Make sufficient passes over entire area to remove roller marks and to produce desired finished surface.

D. Tolerances:

1. Finished surface shall be flush with and match grade, slope, and crown of adjacent surface.

2. Tolerance: Surface smoothness shall not deviate more than plus 1/4 inch or minus 0 when a straightedge is laid across patched area between edges of new pavement and surface of old surfacing.

3.07 FIELD QUALITY CONTROL

A. General: Provide services of an approved certified independent testing laboratory to conduct tests.

B. Field Density Tests:

1. Perform tests from cores or sawed samples.

2. Measure with properly operating and calibrated nuclear density gauge.

3. Maximum Density: In accordance with ASTM D2041, using a sample of mix taken prior to compaction from the same location as the density test sample.

C. Testing Frequency:

1. Quality Control Tests:

a. Asphalt Content, Aggregate Gradation: Once per every 500 tons of mix or once every 4 hours, whichever is greater.

b. Mix Design Properties, Measured Maximum (Rice's) Specific Gravity: Once every 1,000 tons or once every 8 hours, whichever is greater.

2. Density Tests: Once every 500 tons of mix or once every 4 hours, whichever is greater.

END OF SECTION

SECTION 32 15 00
LIMEROCK BASE

PART 1 – GENERAL

1.01 DEFINITIONS

A. Completed Course: Compacted, unyielding, free from irregularities; with smooth, tight, even surface, true to grade, line, and cross section.

B. Completed Lift: Compacted with uniform surface reasonably true to cross-section.

PART 2 – MATERIALS

2.01 LIMEROCK BASE ROCK

A. The material used in limerock base shall be material classified as Miami Oolite or Ocala Formation.

B. The minimum of carbonates of calcium and magnesium in the limerock shall be 70 percent. The maximum percentage of water-sensitive clay material shall be 3.

C. Limerock material shall be uniform in color and not contain cherty or other extremely hard pieces, or lumps, balls, or pockets of sand or clay size material in sufficient quantities as to be detrimental to the proper bonding, finishing, or strength of the limerock base.

D. The limerock base shall be uniformly graded from coarse to fine with 97 percent passing a 3-1/2-inch sieve, 80 percent passing a 2-inch sieve. The fine material shall consist entirely of dust of fracture. All crushing or breaking up, which might be necessary in order to meet such size requirements, shall be done before the material is placed on the road.

E. Physical Qualities:

1. Liquid Limit, AASHTO T89: Maximum 35 percent.

2. Nonplastic.

3. Limerock material shall have an average limerock bearing ratio (LBR) value of not less than 100.

2.02 SOURCE QUALITY CONTROL

A. Contractor: Perform tests necessary to locate acceptable source of materials meeting specified requirements.

B. Final approval of aggregate material will be based on materials' test results on installed materials.

C. Should separation of coarse from fine materials occur during processing or stockpiling, immediately change methods of handling materials to correct uniformity in grading.

PART 3 – EXECUTION

3.01 SUBGRADE PREPARATION

A. As specified in the Contract Documents.

B. Obtain City’s acceptance of subgrade before placement of limerock base rock.

C. Do not place base materials on soft, muddy subgrade.

3.02 EQUIPMENT

A. Use mechanical rock spreaders, equipped with a device that strikes off the rock uniformly to laying thickness, capable of producing even distribution. For areas where the use of a mechanical spreader is not practicable, the Contractor may spread the rock using bulldozers or blade graders.

3.03 HAULING AND SPREADING

A. Hauling Materials:

1. The limerock shall be transported to the point where it is to be used and dumped on the end of the preceding spread.

2. Do not haul over surfacing in process of construction.

3. Loads: Of uniform capacity.

4. Maintain consistent gradation of material delivered; loads of widely varying gradations will be cause for rejection.

B. Spreading Materials:

1. Distribute material to provide required density, depth, grade and dimensions with allowance for subsequent lifts.

2. Produce even distribution of material upon roadway without segregation.

3. Should segregation of coarse from fine materials occur during placing, immediately change methods of handling materials to correct uniformity in grading.

3.04 CONSTRUCTION OF COURSES

A. General: Complete each lift in advance of laying succeeding lift to provide required results and adequate inspection.

B. Limerock Base:

1. Maximum Completed Lift Thickness: 6 inches or equal thickness.

2. Completed Course Total Thickness: As shown on the Drawings.

3. Spread lift on preceding course to required cross-section.

4. Lightly blade and roll surface until thoroughly compacted.

5. Blade or broom surface to maintain true line, grade, and cross-section.

C. Gravel Surfacing:

1. Maximum Completed Lift Thickness: 6 inches or equal thickness.

2. Completed Course Total Thickness: As shown on the Drawings.

3. Spread on preceding course in accordance with cross-section shown.

4. Blade lightly and roll surface until material is thoroughly compacted.

3.05 ROLLING AND COMPACTION

A. Commence compaction of each layer of base after spreading operations and continue until density of 98 percent of maximum density has been achieved as determined by AASHTO T 180.

B. Density tests will be conducted every 500 square yards or as directed by the City.

C. Roll each course of surfacing until material shall not creep under roller before succeeding course of surfacing material is applied.

D. Commence rolling at outer edges of surfacing and continue toward center; do not roll center of road first.

E. When the material does not have the proper moisture content to ensure the required density, wet or dry, as required. When adding water, uniformly mix it in by disking to the full depth of the course that is being compacted. During wetting or drying operations, manipulate as a unit, the entire width and depth of the course that is being compacted.

F. Place and compact each lift to required density before succeeding lift is placed.

G. Bind up preceding course before placing leveling course. Remove floating or loose stone from surface.

H. Blade or otherwise work surfacing as necessary to maintain grade and cross-section at all times, and to keep surface smooth and thoroughly compacted.

I. Surface Defects: Remedy surface defects by loosening and rerolling. Reroll entire area, including surrounding surface, until thoroughly compacted.

J. Finished Surface: True to grade and crown before proceeding with surfacing.

3.06 SURFACE TOLERANCES

A. Finished Surface of Base Course and Leveling Course: Within plus or minus 0.04-foot of grade shown at any individual point.

B. Compacted Surface of Leveling Course: Within 0.04-foot from lower edge of 10-foot straightedge placed on finished surface, parallel to centerline.

C. Overall Average: Within plus or minus 0.01-foot from crown and grade specified.

3.07 GRAVEL DRIVEWAY RESURFACING

A. Replace gravel surfacing on driveways which were gravel surfaced prior to construction.

B. Provide compacted gravel surfacing to depth equal to original, but not less than 4 inches.

C. Leave each driveway in as good or better condition as it was before start of construction.

3.08 FIELD QUALITY CONTROL

A. In-Place Density Tests:

1. Construct base course so areas shall be ready for testing.

2. Allow reasonable length of time for testing laboratory to perform tests and obtain results during normal working hours.

3.09 CLEANING

A. Remove excess material; clean stockpile areas of aggregate.

END OF SECTION

SECTION 32 16 00
CONCRETE CURBS AND SIDEWALKS

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. Furnish and install concrete curbs and sidewalks as indicated in the Drawings.

1.02 SUBMITTALS

A. Comply with the requirements of the Section titled "Submittal Procedures”.

1.03 ABBREVIATIONS

A. AASHTO: American Association of State Highway and Transportation Officials

B. FDOT: Florida Department of Transportation

C. LBR: Limrock Bearing Ratio

1.04 STANDARDS

A. ACI 304: Guide for Measuring, Mixing, Transporting, and Placing Concrete

B. ASTM C94: Standard Specification for Ready-Mixed Concrete

C. ASTM C309: Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete

D. AASHTO M153: Standard Specification for Preformed Sponge Rubber, Cork, and Recycled Rubber Expansion Joint Fillers for Concrete Paving and Structural Construction

E. AASHTO M213: Standard Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)

PART 2 – MATERIALS

2.01 EXPANSION JOINT FILLER

A. 1/2-inch thick, preformed asphalt-impregnated, expansion joint material meeting AASHTO M153 Type I, II, or III, or AASHTO M213, or cellulose fiber types meeting the requirements of AASHTO M213, except the asphalt content is acceptable provided they contain minimum of 0.2 percent copper pentachlorophenate as a preservative and 1 percent water proofing wax.

2.02 CONCRETE

A. Ready-mixed meeting ASTM C94, Option A, with compressive strength of 3,000 psi at 28 days.

B. Maximum Aggregate Size: 1-1/2 inch.

C. Slump: 2 to 4 inches.

2.03 CURING COMPOUND

A. Liquid membrane-forming, clear or translucent, suitable for spray application and meeting ASTM C309, Type 1.

PART 3 – EXECUTION

3.01 FORMWORK

A. Lumber Materials:

1. 2-inch dressed dimension lumber, or metal of equal strength, straight, free from defects that would impair appearance or structural quality of completed curb and sidewalk.

2. 1-inch dressed lumber or plywood may be used where short-radius forms are required.

B. Metals: Steel in new undamaged condition.

C. Setting Forms:

1. Construct forms to shape, lines, grades, and dimensions.

2. Stake securely in place.

D. Bracing:

1. Brace forms to prevent change of shape or movement resulting from placement.

2. Construct short-radius curved forms to exact radius.

E. Tolerances:

1. Do not vary tops of forms from grade line more than 1/8 inch when checked with 10-foot straightedge.

2. Do not vary alignment of straight sections more than 1/8 inch in 10 feet.

3.02 PLACING CONCRETE

A. Excavate to the required depth, place and compact limerock base rock as specified in the Contract Documents. Compact directly under the area and 1 foot beyond each side of the sidewalk and curb.

B. Prior to placing concrete, remove water from excavation and debris and foreign material from forms.

C. Place concrete as soon as possible, and within 1-1/2 hours after adding cement to mix without segregation or loss of ingredients, and without splashing.

D. Place, process, finish, and cure concrete in accordance with applicable requirements of ACI 304, and this section. Wherever requirements differ, the more stringent shall govern.

E. To compact, vibrate until concrete becomes uniformly plastic.

F. All edges shall be smooth and rounded.

3.03 CURB CONSTRUCTION

A. Construct ramps at pedestrian crossings in compliance with FDOT minimum standards. Standards apply to work in the City's Rights of Way.

B. Expansion Joints: Place at maximum 20-foot intervals and at the beginning and end of curved portions of curb, and at connections to existing curbs. Install expansion joint filler at each joint.

C. Gutter minimum slope shall be 0.33% unless otherwise approved by the City.

D. Curb Facing: Do not allow horizontal joints within 7 inches from top of curb.

E. All gutters and curb and gutters shall have a minimum 4" think limerock "curb pad" LBR 100.

F. Contraction Joints:

1. Maximum 10-foot intervals in curb.

2. Provide open joint type by inserting thin, oiled steel sheet vertically in fresh concrete to force coarse aggregate away from joint.

3. Insert steel sheet to full depth of curb.

4. Remove steel sheet with sawing motion after initial set has occurred in concrete and prior to removing front curb form.

5. Finish top of curb with steel trowel and finish edges with steel edging tool.

G. Front Face:

1. Remove front form and finish exposed surfaces when concrete has set sufficiently to support its own weight.

2. Finish formed face by rubbing with burlap sack or similar device to produce uniformly textured surface, free of form marks, honeycomb, and other defects.

3. Remove and replace defective concrete.

4. Apply curing compound to exposed surfaces of curb upon completion of finishing.

5. Continue curing for minimum of 5 days.

H. Backfill curb with earth upon completion of curing period, but not before 7 days has elapsed since placing concrete.

1. Backfill shall be free from rocks 2 inches and larger and other foreign material.

2. Compact backfill firmly.

3.04 SIDEWALK CONSTRUCTION

A. Thickness: 6 inches.

B. Connection to Existing Sidewalk:

1. Remove old concrete back to an existing contraction joint.

2. Clean the surface.

3. Apply a neat cement paste immediately prior to placing new sidewalk.

C. Expansion Joints: Place at maximum 20-foot intervals, at adjacent curb expansion joint, where sidewalk ends at curb, and around posts, poles, or other objects penetrating sidewalk. Install expansion joint filler at each joint.

D. Contraction Joints:

1. Provide transversely to walks at locations opposite contraction joints in curb.

2. Dimensions: 3/16-inch by 1-inch weakened plane joints.

3. Construct straight and at right angles to surface of walk.

E. Finish:

1. Broom surface with fine-hair broom at right angles to length of walk and tool at edges, joints, and markings.

2. Ensure that the surface variations are not more than ¼ inch under a 10-foot straightedge, or more than 1/8 inch on a 5-foot transverse section.

3. Mark walks transversely at 5-foot intervals, or in pattern shown on Drawings, with jointing tool; finish edges with rounded steel edging tool.

4. Apply curing compound to exposed surfaces upon completion of finishing.

5. Protect sidewalk from damage and allow to cure for at least 7 days.

F. Curb Ramps:

1. All curb ramps and detectable warnings shall comply with the current FDOT Standard Plans for Road Construction.

2. Comply with Standard Plans Index: 522-02 (formerly Index 304) titled “Detectable Warnings and Sidewalk Curb Ramps”.

END OF SECTION

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SECTION 32 17 23
PAVEMENT MARKINGS

PART 1 – GENERAL

1.01 STANDARD SPECIFICATIONS

A. When referenced in this section, Standard Specifications shall mean Florida Department of Transportation (FDOT), Standard Specifications for Road and Bridge Construction, current edition. All Pavement Markings and Signage shall conform to the Broward County Traffic Engineering Division Standards, latest revision.

1.02 SUBMITTALS

A. Submit shop drawings of the proposed products for review in accordance with the Section titled “Submittal Procedures”.

PART 2 – MATERIALS

2.01 PAINT

A. Color: White, yellow, or blue traffic striping meeting the requirements of Broward County Traffic Engineering Division and the Standard Specifications.

B. Homogeneous, easily stirred to smooth consistency, with no hard settlement or other objectionable characteristics during a storage period of 6 months.

2.02 THERMOPLASTIC STRIPING

A. White or yellow thermoplastic striping material meeting the requirements of Broward County Traffic Engineering Division and the Standard Specifications.

2.03 RAISED REFLECTIVE MARKERS

A. Metallic or nonmetallic, or prismatic reflector type, of permanent colors retaining color and brightness under action of traffic.

B. Rounded surfaces presenting a smooth contour to traffic. The minimum area of each reflective face shall be 2-1/2 inches squared.

C. Marker and adhesive epoxy in accordance with ASTM D4280

D. Markers shall meet the requirements of Broward County Traffic Engineering Division and the Standard Specifications.

2.04 GLASS SPHERES

A. Glass spheres shall be of a composition designed to be highly resistant to traffic wear and to the effects of weathering.

B. In accordance with AASHTO M247, Type I with moisture resistant coating or a formulation specified by the traffic striping material manufacturer and the Broward County Traffic Engineering Division and the Standard Specifications.

PART 3 – EXECUTION

3.01 SURFACE PREPARATION

A. Cleaning:

1. Thoroughly clean surfaces to be marked before application of pavement marking material.

2. Remove dust, dirt, and other granular surface deposits by sweeping, blowing with compressed air, rinsing with water or a combination of these methods.

3. Completely remove rubber deposits, surface laitance, existing paint markings, and other coatings adhering to pavement with scrapers, wire brushes, sandblasting, approved chemicals, or mechanical abrasion.

4. Scrub areas of old pavement affected with oil or grease with several applications of trisodium phosphate solution or other approved detergent or degreaser, and rinse thoroughly after each application.

5. Surfaces shall be completely free of dry dirt and ice, and dry of water at the time of application of any of the materials specified herein.

6. Oil-Soaked Areas: After cleaning, seal with cut shellac to prevent bleeding through the new paint.

7. Reclean surfaces when Work has been stopped due to rain.

8. Existing Pavement Markings:

   a. Remove existing pavement markings that may interfere or conflict with newly applied marking patterns, or that may result in a misleading or confusing traffic pattern.

   b. Do not apply thermoplastic markings over existing preformed or thermoplastic markings.

c. Perform grinding, scraping, sandblasting or other operations so finished pavement surface is not damaged.

B. Pretreatment for Early Striping: Where early striping is required on rigid pavements, pretreat with an aqueous solution containing 3 percent phosphoric acid and 2 percent zinc chloride.

C. New Concrete Pavement:

1. Allow a minimum cure time of 30 days before cleaning and marking.

2. Clean by either sandblasting or water blasting to the following results:

a. No visible evidence of curing compound on peaks of textured concrete surface.

b. No heavy puddled deposits of curing compound in valleys of textured concrete surface.

c. Remaining curing compound is intact, with loose and flaking material completely removed.

d. Peaks of textured pavement surface are rounded in profile and free of sharp edges and irregularities.

3. Allow a minimum drying time of 24 hours after water blasting before applying thermoplastic markings.

3.02 ALIGNMENT FOR MARKINGS

A. The Contractor shall be responsible for all measurements, reference points and marks, string lining, and any other steps required in establishing pavement marking locations and alignment. On tangents and on curves up to 1 degree, the alignment of the marking shall not deviate from the string line by more than 1 inch. On curves exceeding 1 degree, the maximum permissible deviation shall be 2 inches. All alignment width and location shall conform to the details shown on the Drawings.

3.03 PAINT APPLICATION

A. General:

1. Thoroughly mix pigment and vehicle together prior to application and keep thoroughly agitated during application.

2. Do not add thinner.

3. Apply only when air and pavement temperatures are above 40 degrees Fahrenheit and less than 95 degrees Fahrenheit. Maintain paint temperature within these same limits.

4. Apply only when the surface is dry.

5. Do not apply when conditions are windy to the point of causing overspray or fuzzy line edges.

6. New Asphalt Pavement: Allow a minimum pavement cure time as recommended by the manufacturer before applying paint.

7. Provide guidelines and templates to control paint application.

8. Take special precautions in marking numbers, letters, and symbols.

9. Sharply outline edges of markings and apply without running or spattering.

B. Rate of Application:

1. Reflective Markings:

a. Paint: Apply evenly, 105 plus or minus 5 square feet per gallon.

b. Glass Beads: Apply uniformly, 6 plus or minus 0.5 pounds of glass spheres per gallon of paint.

2. Nonreflective Markings: Apply paint evenly to pavement surface at a rate of 105 plus or minus 5 square feet per gallon.

3. On new pavement or new asphalt surface treatments, apply two coats of paint at a uniform rate of 210 square feet per gallon.

C. Drying:

1. Provide maximum drying time to prevent undue softening of bitumen and pickup, displacement, or discoloration by traffic.

2. If drying is abnormally slow, discontinue painting operations until the cause is determined and corrected.

3.04 THERMOPLASTIC MARKING APPLICATION

A. Following specified surface preparation, prime and apply marking and glass beads to provide a reflectorized strip as shown on Drawings.

B. The material shall be applied to the pavement by the extrusion method only, wherein one side of extrusion shaping die is the pavement and the other sides are formed by suitable equipment for heating and controlling the flow of the material.

C. Application Temperatures:

1. Pavement Surface: Minimum 40 degrees Fahrenheit and rising.

2. Thermoplastic: Minimum 375 degrees Fahrenheit, maximum 425 degrees Fahrenheit.

D. Primer:

1. On portland cement concrete and existing asphalt pavements, apply epoxy resin primer/sealer according to the thermoplastic manufacturer's recommendations.

2. All primer/sealer to dry prior to applying thermoplastic.

E. Thermoplastic Marking:

1. Extrude in a molten state, free of dirt or tint. at a thickness of 0.10 to 0.15 inch for lane lines and 0.07 to 0.10 inch for edge or other lines in accordance with FDOT Design Standards.

2. Apply centerline, skip line, edge line, and other longitudinal type markings with a mobile applicator.

3. Apply special markings, crosswalks, stop bars, legends, arrows, and similar patterns with a portable, extrusion-type applicator.

F. Glass Bead Application:

1. Immediately after marker application, mechanically apply such that the beads are held by and imbedded in the surface of the molten material.

2. Application Rate: One pound per 20 square feet of compound.

G. Cool completed marking to ambient temperature prior to allowing vehicular traffic.

3.05 INSTALLATION OF RAISED REFLECTIVE MARKERS

A. Apply markers to the bonding surface using bituminous adhesives only.

B. Apply the adhesive to the binding surface (not the marker) so that 100 percent of the bonding area of the marker will be covered.

C. Align markers carefully, projecting no more than 3/4-inch above level of pavement. Reflective face of the marker shall be perpendicular to a line parallel to the roadway

centerline. Do not install markers over longitudinal or transverse joints of the bonding surface.

D. Spacing: As shown on the Drawings.

E. Immediately remove excess adhesive from the bonding surface and exposed surface of the marker.

F. Use only a mineral spirits meeting Federal Specifications TT-T-291 to remove adhesive from exposed faces of markers.

3.06 GLASS BEAD APPLICATION

A. Apply immediately following application of paint.

B. Evenly distribute.

C. Rate: 10 pounds per gallon of paint.

3.07 PROTECTION

A. The Contractor shall erect adequate warning signs and/or provide sufficient number of flaggers to work safely.

B. Take all necessary precautions for the protection of the materials and safety of the public.

C. Protect surfaces from disfiguration by paint spatters, splashes, spills, or drips.

3.08 CLEANUP

A. Remove paint spatters, splashes, spills, or drips from Work and staging areas and areas outside of the immediate Work area where spills occur.

END OF SECTION

SECTION 32 92 23
SODDING

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Preparation of subsoil, placing topsoil, fertilizing, sod installation, and maintenance as required to complete Work as shown on drawings and specified in this Section.

1.02 REFERENCES

A. Turfgrass Producers International (TPI): Guideline Specifications to Turfgrass Sodding.

1.03 DEFINITIONS

A. FNGLA: Florida Nursery, Growers and Landscape Association.

1.04 QUALITY ASSURANCE

A. Sod Producer: Company specializing in sod production.

B. Installer: Company that specializes in sod installation. The installer shall have personnel with one of the following certifications:

1. Florida-Friendly Landscaping™ Certified Professional (FFLCP)

2. FNGLA Certified Landscape Contractor (FCLC) program

3. FNGLA Certified Landscape Technician (FCLT) program

C. Sod: Minimum age of 18 months, with root development that will support its own weight, without tearing, when suspended vertically by holding the upper two corners.

D. Submit certification for the Installer.

1.05 REGULATORY REQUIREMENTS

A. Comply with regulatory agencies for fertilizer and herbicide composition and application.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver sod on pallets. Protect exposed roots from dehydration.

B. Do not deliver more sod than can be laid within 24 hours.

C. Transporting:

1. Sod transported to the project in open vehicles shall be covered with tarpaulin or other suitable covers securely fastened to the body of the vehicle to prevent injury to the sod material. Closed vehicles shall be adequately ventilated to prevent overheating of the sod. Evidence of inadequate protection against drying out during transit shall be cause for rejection.

2. Sod shall be kept moist, fresh and protected at all times. Such protection shall encompass the entire period during which the sod is in transit, being handled, or in temporary storage.

3. Upon arrival at the site of work, sod shall be inspected for proper shipping procedures. Should the roots be dried out, the Engineer will reject the sod. When sod has been rejected, the Contractor shall remove it at once from the area of the work and replace it.

4. Unless otherwise authorized by the Engineer, the Contractor shall notify the Engineer at least 48 hours in advance of the anticipated delivery date of sod material. A legible copy of the invoice, showing species and variety of sod included for each shipment shall be submitted to the Engineer.

PART 2 – PRODUCTS

2.01 SOD

A. Sod shall be nursery grown grade.

B. Sod: All sod shall be Floratam St. Augustine (Stenotaphrum secundatum).

C. Sod pads incapable of supporting their own weight, when held vertically with a firm grasp, shall be rejected.

2.02 TOPSOIL

A. General: Uniform mixture of 75 percent good grade of clean, salt free, weed free sand and 25 percent organic material in a loose friable condition, free from objects larger than 1-1/2 inches maximum dimension, and free of subsoil, roots, grass, other foreign matter, hazardous or toxic substances, and deleterious material that may be harmful to plant growth or may hinder grading, planting, or maintenance.

B. Textural Amendments: Amend as necessary to conform to required composition.

C. Source: Import topsoil if onsite material fails to meet specified requirements or is insufficient in quantity.

D. 95% of topsoil shall pass a ¼ inch sieve.

E. Organic matter content shall be 4% to 12% of total dry weight.

2.03 SOURCE QUALITY CONTROL

A. Topsoil Analysis/Testing: Performed by county or state soil testing service or approved certified independent testing laboratory.

B. Should soil tests prove the topsoil too alkaline or above the accepted minimum for salt content, the topsoil shall be removed and replaced by acceptable material at Contractor's expense.

2.04 FERTILIZER

A. As recommended by sod producer.

2.05 WATER

A. Clean, fresh, and free of substances or matter which could inhibit vigorous growth of grass.

PART 3 – EXECUTION

3.01 INSPECTION

A. Verify prepared soil base is ready to receive the work of this Section.

B. Beginning of installation means acceptance of existing site conditions.

3.02 PREPARATION OF SUBSOIL

A. Prepare subsoil to eliminate uneven areas and low spots. Maintain lines, levels, profiles and contours. Make changes in grade gradual. Blend slopes into level areas.

B. Remove foreign materials and undesirable plants and their roots. Do not bury foreign material beneath areas to be sodded. Remove contaminated subsoil.

C. Scarify subsoil to a depth of 4 inches where topsoil is to be placed. Repeat cultivation in areas where equipment, used for hauling and spreading topsoil, has compacted subsoil.

3.03 PLACING TOPSOIL

A. Spread topsoil to a minimum depth of 2 inches over area to be sodded.

B. Place topsoil during dry weather and on dry, unfrozen subgrade.

C. Remove vegetable matter and foreign non-organic material while spreading.

D. Grade to eliminate rough, low, or soft areas, and to ensure positive drainage.

3.04 FERTILIZING

A. Apply fertilizer in accordance with manufacturer's instructions.

B. Apply after smooth raking of topsoil and prior to installation of sod.

C. Apply fertilizer no more than 48 hours before laying sod.

D. Mix thoroughly into upper 2 inches of topsoil.

E. Lightly water to aid the dissipation of fertilizer.

3.05 LAYING SOD

A. Moisten prepared surface immediately prior to laying sod.

B. Lay sod within 24 hours after harvesting to prevent deterioration.

C. Lay sod tight with no open joints visible, and no overlapping; stagger end joints 12 inches minimum. Do not stretch or overlap sod pieces.

D. Lay smooth. Align with adjoining grass areas. Place top elevation of sod 1/2 inch below adjoining paving or curbs.

E. On slopes 6 inches per foot and steeper, lay sod perpendicular to slope and secure every row with wooden pegs at maximum 2 feet on center. Drive pegs flush with soil portion of sod.

F. Prior to placing sod on slopes exceeding 8 inches per foot or where indicated, place wire mesh over topsoil. Securely anchor sod in place over wire mesh and topsoil with wood pegs sunk firmly into the ground.

G. Water sodded areas immediately after installation. Saturate sod to 4 inches of soil.

H. After sod and soil have dried, roll sodded areas to ensure good bond between sod and soil and to remove minor depressions and irregularities. Roll sodded areas with roller not exceeding 150 lbs per foot of roller width.

3.06 MAINTENANCE

A. Maintenance Period: Begin maintenance immediately after planting sod and continue for at least eight weeks or until final acceptance by the Owner, whichever is longer.

B. Mow grass at regular intervals to maintain at a maximum height of 2½ inches.

C. Neatly trim edges and hand clip where necessary.

D. Immediately remove clippings after mowing and trimming.

E. Water to prevent grass and soil from drying out.

F. Roll surface to remove minor depressions or irregularities.

G. Control growth of weeds. Apply herbicides in accordance with manufacturer's instructions. Remedy damage resulting from improper use of herbicides.

H. Immediately replace sod to areas which show deterioration or bare spots.

I. Protect sodded areas with warning signs during maintenance period.

3.07 FIELD QUALITY CONTROL

A. Eight weeks after sodding is complete and on written notice from Contractor, City will, within 15 days of receipt, determine if the sod has been satisfactorily established.

B. If the sod is not satisfactorily established, the Contractor shall replace the sod and repeat the requirements of this Section.

END OF SECTION

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DIVISION 40 – PROCESS INTERCONNECTIONS

SECTION 40 05 00
BASIC MECHANICAL REQUIREMENTS

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish and install to the required line and grade, all piping together with all fittings and appurtenances, required for a complete installation. Piping to be backfilled and/or encased in concrete is considered to be buried piping. Piping that is not buried is considered to be exposed.

B. The Contractor shall furnish and install fittings, couplings, connections, sleeves, adapters, harness rods and closure pieces as required to connect pipelines of dissimilar materials and/or sizes herein included under this Section and other concurrent Contracts for a complete installation.

C. The Contractor shall furnish all labor, materials, equipment, tools, and services required for the furnishing, installation and testing of all piping as shown on the Drawings, specified in this Section and required for the Work. Piping shall be furnished and installed of the material, sizes, classes, and at the locations shown on the Drawings and/or designated in this Section. Piping shall include all fittings, adapter pieces, couplings, closure pieces, harnessing rods, hardware, bolts, gaskets, wall sleeves, wall pipes, hangers, supports, and other associated appurtenances for required connections to equipment, valves, or structures for a complete installation.

D. Piping assemblies under 4-inch size shall be generally supported on walls and ceilings, unless otherwise shown on the Drawings or ordered by the Engineer, being kept clear of openings and positioned above "headroom" space. Where practical, such piping shall be run in neat clusters, plumb and level along walls, and parallel to overhead beams.

E. The Contractor shall provide taps on piping where required or shown on the Drawings. Where pipe or fitting wall thicknesses are insufficient to provide the required number of threads, a boss or pipe saddle shall be installed.

F. The work shall include, but not be limited to, the following:

1. Connections to existing pipelines.

2. Test excavations necessary to locate or verify existing pipe and appurtenances.

3. Installation of all new pipe and materials required for a complete installation.

4. Cleaning, testing and disinfecting as required.

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G. Elastomers found in the piping and valves of conveyance systems carrying chloramines-treated water that contact the water shall be made of peroxide-cured EPDM. This requirement supersedes any specified elastomer in the individual pipe and valve specifications exposed to the product for this conveyance application.

H. All piping, fittings, valves including gaskets and lining provided for conveying potable water, coming into contact with conveyed potable water, used in potable water treatment, or conveying chemicals used in potable water treatment shall be certified as meeting Standard NSF/ANSI 61.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Division 01 – General Requirements

B. Division 02 – Existing Conditions

C. Division 05 – Metals

D. Division 09 – Finishes

E. Division 26 – Electrical

F. Division 46 – Water and Wastewater Equipment

1.03 MATERIAL CERTIFICATION AND SHOP DRAWINGS

A. The Contractor shall furnish to the Owner (through the Engineer) a Material Certification stating that the pipe materials and specials furnished under this Section conform to all applicable provisions of the corresponding Specifications. Specifically, the Certification shall state compliance with the applicable standards (ASTM, AWWA, ANSI, etc.) for fabrication and testing.

B. Shop Drawings for major piping (2-inches in diameter and greater) shall be prepared and submitted in accordance with Section 01 33 00 – Submittal Procedures. In addition to the requirements of Section 01 33 00 – Submittal Procedures, the Contractor shall submit laying schedules and detailed Drawings in plan and profile for all piping as specified and shown on the Drawings.

C. Shop Drawings shall include, but not be limited to, complete piping layout, pipe material, sizes, class, locations, necessary dimensions, elevations, supports, hanger details, pipe joints, and the details of fittings including methods of joint restraint. No fabrication or installation shall begin until Shop Drawings are approved by the Engineer.

D. For materials and equipment subject to Standard NSF/ANSI 61 certification, shop drawings shall include documentation demonstrating such certification.

PART 2 – PRODUCTS

2.01 GENERAL

A. All specials and every length of pipe shall be marked with the manufacturer's name or trademark, size, class, and the date of manufacture. Special care in handling shall be exercised during delivery, distribution, and storage of pipe to avoid damage and unnecessary stresses. Damaged pipe will be rejected and shall be replaced at the Contractor's expense. Pipe and specials stored prior to use shall be stored in such a manner as to keep the interior free from dirt and foreign matter.

B. Testing of pipe before installation shall be as described in the corresponding ASTM or AWWA Specifications and in the applicable standard specifications listed in the following sections. Testing after the pipe is installed shall be as specified in Part 3.

C. Joints in piping shall be of the type as specified in the appropriate Piping System Schedule in Section 40 06 20 – Process Pipe, Valve, and Gate Schedules.

D. All buried piping shall have restrained joints for thrust protection unless otherwise specified or shown on the Drawings. All exposed piping shall have flanged joints, unless otherwise specified or shown on the Drawings.

E. The Drawings indicate work affecting existing piping and appurtenances. The Contractor shall excavate test pits as required of all connections and crossings which may affect the Contractor's work prior to ordering pipe and fittings to determine sufficient information for ordering materials. The Contractor shall take whatever measurements that are required to complete the work as shown or specified.

2.02 WALL PIPES

A. Where wall sleeves or wall pipes occur in walls that are continuously wet on one or both sides, they shall have water stop flanges at the center of the casting or as shown on the Drawings. Ends of wall pipes shall be flange, mechanical joint, plain end, or bell as shown on the Drawings, or as required for connection to the piping. Wall pipes shall be of the same material as the piping that they are connected to. If welded waterstop flanges are employed, welds shall be 360 degree continuous on both sides of flange. Unless otherwise shown on the Drawings, waterstop flanges shall conform to the minimum dimensions shown below:

Pipe Size	Waterstop Flange Diameter	Waterstop Flange Thickness
4" - 12"	OD + 3.10"	0.50"
14" - 24"	OD + 4.15"	0.75"
30" - 36"	OD + 4.50"	1.00"
42" - 48"	OD + 5.00"	1.25"

Pipe Size	Waterstop Flange Diameter	Waterstop Flange Thickness
54"	OD + 5.90"	1.50"

2.03 SLEEVES

A. Unless shown otherwise, all piping passing through walls and floors shall be installed in sleeves or wall castings accurately located before concrete is poured or placed in position during construction of masonry walls. Sleeves passing through floors shall extend from the bottom of the floor to a point 3 inches above the finished floor, unless shown otherwise. Water stop flanges are required on all sleeves located in floors or walls which are continually wet or under hydrostatic pressure on one or both sides of the floor or wall.

B. Sleeves shall be cast iron, black steel pipe, or fabricated steel in accordance with details shown on the Drawings. If not shown on the Drawings, the Contractor shall submit to the Engineer the details of sleeves he proposes to install; and no fabrication or installation thereof shall take place until the Engineer's approval is obtained. Steel sleeves shall be fabricated of structural steel plate in accordance with the standards and procedures of AISC and AWS. Steel sleeve surfaces shall receive a commercial sandblast cleaning and then be shop painted in accordance with Section 09 90 00 – Painting.

C. When shown on the Drawings or otherwise required, the annular space between the installed piping and sleeve shall be completely sealed against a maximum hydrostatic pressure of 20 psig. Seals shall be mechanically interlocked, solid rubber links, trade name "Link-Seal", as manufactured by Garlock Pipeline Technologies (GPT) or equal. Rubber link, seal-type, size, and installation thereof, shall be in strict accordance with the manufacturer's recommendations. For non-fire rated walls and floors, pressure plate shall be glass reinforced nylon plastic with EPDM rubber seal and 316 stainless steel bolts and nuts. For fire rated walls and floors, two independent seals shall be provided consisting of low carbon steel, zinc galvanized pressure plates, silicon rubber seals and 316 stainless steel bolts and nuts.

D. Cast iron mechanical joint adapter sleeves shall be Clow # 1429, as manufactured by the Clow Corp., or equal. Mechanical joint adapter sleeves shall be provided with suitable gasket, follower ring, and bolts to affect a proper seal. In general, sleeves installed in walls, floors, or roofs against one side of which will develop a hydrostatic pressure, or through which leakage of liquid will occur, shall be so sealed. If welded waterstop flanges are employed, welds shall be 360 degree continuous on both sides of flange.

2.04 SOLID SLEEVE COUPLINGS (FOR BURIED SERVICE THROUGH 54-INCH)

A. Solid sleeve couplings shall be used to connect buried service piping where shown on the Drawings. Solid sleeves shall be ductile iron, long body and shall conform to the requirements of ANSI A21.10 (AWWA C110). Unless otherwise shown or specified, solid

sleeve couplings shall be Style A11760 as manufactured by American Cast Iron Pipe Co., or equal. Solid sleeve couplings shall be restrained with wedge-type restraining glands to meet the pressures specified in 40 06 20 – Schedules.

B. Alternatively, EBAA Iron 3800 Mega-Coupling is acceptable.

2.05 FLANGED COUPLING ADAPTERS

A. Flanged coupling adapters shall be furnished as required and as shown on the Drawings.

B. Flanged coupling adapters shall be of ductile iron or carbon steel construction and shall be rated for the same pressure as the connected piping.

C. All flanged coupling adapters shall be harnessed by tying the adapter to the nearest pipe joint flange using threaded rods and rod tabs unless otherwise approved by the Engineer.

D. Flanged coupling adapters shall be manufactured by Smith-Blair Model 912 or 913, Romac Industries Model FCG or FC 400, Dresser Industries Model 128-W, or equal.

E. Flanged coupling adapters shall be provided with manufacturer's fusion bonded epoxy painting system.

2.06 DISMANTLING JOINTS

A. Dismantling joints shall be furnished at locations shown on the Drawings.

B. Dismantling joints for sizes less than 12-inch shall be of ductile iron or carbon steel construction and shall be rated for the same pressure as the connected piping. Dismantling joints for sizes greater than 12-inches shall be of carbon steel construction and shall have a minimum working pressure rating equal to or exceeding the specified test pressure of the connected pipe.

C. Flanges for dismantling joints shall match the bolt pattern and pressure rating of the flanges for the connected piping.

D. All dismantling joints shall be restrained utilizing restraining rods provided by the manufacturer. Restraining rods shall be constructed from ASTM A193 Grade B7 steel. Restraining rods and restraint system shall be installed in strict accordance with manufacturer's recommendations.

E. Dismantling joints shall be provided with manufacturer's fusion bonded epoxy painting system.

F. Dismantling joints shall be manufactured by Smith Blair Model 975, Romac Industries Model DJ400, or equal.

2.07 GROOVED COUPLINGS

A. Grooved end pipe couplings shall be furnished as specified or shown on the Drawings.

B. Materials shall be of malleable iron and couplings shall be rated for the same pressures as the connecting piping.

C. Gaskets shall be rubber. Bolts and nuts shall be heat treated carbon steel track bolts and shall be plated.

D. After installation, buried couplings shall receive two heavy coats of an approved coal tar which is compatible with the finish of the coupling. Exposed couplings shall be painted in accordance with Section 09 90 00 – Painting.

E. Couplings shall be manufactured by Victaulic Company of America Style 31 or equal.

2.08 TAPPING SLEEVES AND TAPPING SADDLES

A. Tapping sleeves shall be similar to Mueller Outlet Seal, American Uniseal or Kennedy Square Seal. All sleeves shall have a minimum working pressure of 150 psi. All sleeves larger than twelve (12) inches shall be ductile iron. All taps shall be machine drilled; no burned taps will be allowed.

B. Tapping saddles may be used on mains sixteen (16) inches and larger where the required tap size does not exceed one-half the size of the main (i.e. 8-inch tapping saddle for use on a 16-inch main). Tapping saddles shall be manufactured of ductile iron providing a factor of safety of at least 2.5 at a working pressure of 250 psi. Saddles shall be equipped with a standard AWWA C-110-77 flange connection on the branch. Sealing gaskets shall be "O" ring type, high quality molded rubber having an approximate seventy durometer hardness, placed into a groove on the curved surface of the tapping saddles. Straps shall be of alloy steel. The tapping saddle shall be the American tapping saddle, U.S. Pipe tapping saddle, or equal. All taps shall be machine cut, no burned taps will be allowed.

2.09 UNIONS

A. For ductile iron, carbon steel, and grey cast iron pipes assembled with threaded joints and malleable iron fittings, unions shall conform to ANSI B16.39.

B. For copper piping, unions shall have ground joints and conform to ANSI B16.18.

C. For PVC and CPVC piping, unions shall be socket weld type with Viton O-ring.

2.10 THERMOPLASTIC TUBING AND FITTINGS

A. Thermoplastic tubing shall be manufactured from polyallomer tubing. Tubing shall be protected from ultraviolet radiation degradation with a black coating or integral color

conforming to ASTM D-1248, Type 1, Class C, Category 3. Fittings and connectors used with thermoplastic tubing shall be the flareless tube type constructed of brass conforming to SAE CA377, SAE CA360 or equal. Brass sleeves shall be used.

B. Assembly of the thermoplastic tubing shall consist of pushing the tubing into the fitting and hand tightening the nut with final tightening with a wrench. Care shall be taken not to overtighten the nut. Plastic tube racks and bend holders shall be provided for holding the tubing in position. Needle valves used with thermoplastic tubing shall be the globe type constructed with a brass body, stem and seat and Buna-N "O"-ring seals. Installation shall be in accordance with the manufacturer's recommendations. Thermoplastic tubing shall be the Impolene (polyallomer) system and needle valves, fittings and connectors shall be the Poly-Flo with 261 UB Universal Nut and Sleeve system as manufactured by Imperial Eastman, or equal.

2.11 HEAT TRACED PIPING (NOT USED)

2.12 FLEXIBLE RESTRAINED EXPANSION JOINTS (NOT USED)

PART 3 – EXECUTION

3.01 INSTALLATION

A. All piping shall be installed by skilled workmen and in accordance with the best standard practice for piping installation as shown on the Drawings, specified or recommended by the pipe manufacturer. Proper tools and appliances for the safe and convenient handling and installing of the pipe and fittings shall be used. Great care shall be taken to prevent any pipe coating from being damaged on the inside or outside of the pipe and fittings. All pieces shall be carefully examined for defects, and no piece shall be installed which is known to be cracked, damaged, or otherwise defective. If any defective pieces should be discovered after having been installed, they shall be removed and replaced with a sound one in a satisfactory manner by the Contractor and at his own expense. Pipe and fittings shall be thoroughly cleaned before they are installed and shall be kept clean until they are accepted in the complete work. All piping connections to equipment shall be provided with unions or coupling flanges located so that piping may be readily dismantled from the equipment. At certain applications, Dresser, Victaulic, or equal, couplings may also be used. All piping shall be installed in such a manner that it will be free to expand and contract without injury to itself or to structures and equipment to which it is connected. All piping shall be erected to accurate lines and grades with no abrupt changes in line or grade and shall be supported and braced against movement, temporary, or permanent. All exposed piping shall be installed with vertical and horizontal angles properly related to adjoining surfaces or pipes to give the appearance of good workmanship. Unless otherwise shown or approved, provided a minimum headroom clearance under all piping of 7 feet 6 inches.

B. Unless otherwise shown or specified, all waste and vent piping shall pitch uniformly at a 1/4-inch per foot grade and accessible cleanouts shall be furnished and installed as

shown and as required by local building codes. Installed length of waste and vent piping shall be determined from field measurements in lieu of the Drawings.

C. All excavation shall be made in such a manner and to such widths as will provide ample room for properly installing the pipe and permit thorough compaction of backfill around the pipe. The minimum trench widths shall be in strict accordance with the "Trench Width Excavation Limits" as shown on the Drawings. All excavation and trenching shall be done in strict accordance with these specifications and all applicable parts of the OSHA Regulations, 29CFR 1926, Subpart P.

D. ALL EXCAVATION REQUIRED BY THIS CONTRACT SHALL BE UNCLASSIFIED. NO ADDITIONAL PAYMENT WILL BE MADE FOR ROCK EXCAVATION REQUIRED FOR THE INSTALLATION OF PIPE OR STRUCTURES SHOWN ON THE DRAWINGS.

E. Enlargements of the trench shall be made as needed to give ample space for operations at pipe joints. The width of the trench shall be limited to the maximum dimensions shown on the Drawings, except where a wider trench is needed for the installation of and work within sheeting and bracing. Except where otherwise specified, excavation slopes shall be flat enough to avoid slides which will cause disturbance of the subgrade, damage to adjacent areas, or endanger the lives or safety of persons in the vicinity.

F. Hand excavation shall be employed wherever, in the opinion of the Engineer, it is necessary for the protection of existing utilities, poles, trees, pavements, or obstructions.

G. No greater length of trench in any location shall be left open, in advance of pipe laying, than shall be authorized or directed by the Engineer and, in general, such length shall be limited to approximately one hundred (100) feet. The Contractor shall excavate the trenches to the full depth, width and grade indicated on the Drawings including the relevant requirements for bedding. The trench bottoms shall then be examined by the Engineer as to the condition and bearing value before any pipe is laid or bedding is placed.

H. No pressure testing shall be performed until the pipe has been properly backfilled in place. All pipe passing through walls and/or floors shall be provided with wall pipes or sleeves in accordance with the specifications and the details shown on the Drawings. All wall pipes shall be of ductile iron and shall have a water stop located in the center of the wall. Each wall pipe shall be of the same class, thickness, and interior coating as the piping to which it is joined. All buried wall pipes shall have a coal tar outside coating on exposed surfaces.

I. JOINT DEFLECTION SHALL NOT EXCEED 75 PERCENT OF THE MANUFACTURER’S RECOMMENDED DEFLECTION. Excavation and backfilling shall conform to the requirements of Section 31 23 16 – Excavation, and Section 31 23 33 – Trenching and Backfill, and as specified herein. Maximum trench widths shall conform to the Trench Width Excavation Limits shown on the Drawings. All exposed, submerged,

and buried piping shall be adequately supported and braced by means of hangers, concrete piers, pipe supports, or otherwise as may be required by the location.

J. Following proper preparation of the trench subgrade, pipe and fittings shall be carefully lowered into the trench so as to prevent dirt and other foreign substances from gaining entrance into the pipe and fittings. Proper facilities shall be provided for lowering sections of pipe into trenches. UNDER NO CIRCUMSTANCES SHALL ANY OF THE MATERIALS BE DROPPED OR DUMPED INTO THE TRENCH.

K. Water shall be kept out of the trench until jointing and backfilling are completed. When work is not in progress, open ends of pipe, fittings, and valves shall be securely closed so that no water, earth, or other substance will enter the pipes, fitting, or valves. Pipe ends left for future connections shall be valved, plugged, or capped, and anchored as required.

L. All piping shall be installed in such a manner that it will be free to expand and/or contract without injury to itself or to structures and equipment to which it is connected. All piping shall be erected to accurate lines and grades with no abrupt changes in line or grade and shall be supported and braced against movement, temporary, or permanent. All exposed piping shall be installed with vertical and horizontal angles properly related to adjoining surfaces or pipes to give the appearance of good workmanship. Pipes crossing within a vertical distance of less than or equal to one (1) foot shall be encased and supported with concrete at the point of crossing to prevent damage to the adjacent pipes as shown on the Drawings.

M. The full length of each section of pipe shall rest solidly upon the bed of the trench, with recesses excavated to accommodate bells, couplings, joints, and fittings. Before joints are made, each pipe shall be well bedded on a solid foundation; and no pipe shall be brought into position until the preceding length has been thoroughly bedded and secured in place. Pipe that has the grade or joint disturbed after laying shall be taken up and re-laid by the Contractor at his own expense. Pipe shall not be laid in water or when trench conditions are unsuitable for work.

N. Proper and suitable tools and appliances for the safe convenient handling and laying of pipe shall be used and shall in general agree with manufacturer's recommendations.

O. AT THE CLOSE OF EACH WORK DAY, THE END OF THE PIPELINE SHALL BE TIGHTLY SEALED WITH A CAP OR PLUG SO THAT NO WATER, DIRT, OR OTHER FOREIGN SUBSTANCE MAY ENTER THE PIPELINE, AND THIS PLUG SHALL BE KEPT IN PLACE UNTIL PIPE LAYING IS RESUMED.

P. During the laying of pipe, each pipe manufacturer shall provide his own supervisor to instruct the Contractor's pipe laying personnel in the correct procedure to be followed.

Q. Ordinarily only full lengths of pipe (as furnished by the pipe manufacturer) shall be used exceptions: closure pieces at manholes and areas where joint deflection is required.

R. For gravity sewer installations, the Contractor shall use a laser device to maintain the trench and pipe alignment. The laser device shall be re-checked for correct elevation and pipe alignment prior to pipe installation if the device is left in the pipe overnight. Corrected invert elevations at each manhole and any adjustments will be coordinated and approved by the Engineer.

S. ALL PIPING SHALL HAVE TYPE "A" BEDDING AS SHOWN ON THE DRAWINGS, UNLESS OTHERWISE SPECIFIED HEREIN OR INDICATED ON THE DRAWINGS.

T. Detector tape shall be installed 12 inches below final grade and directly above all buried potable water piping. The tape shall be blue and silver and shall be clearly and permanently labeled "Water". Detector tape shall be Lineguard III as manufactured by Lineguard, Inc., or equal.

U. AT THE CLOSE OF WORK EACH DAY, PIPELINE TRENCHES SHALL BE COMPLETELY BACKFILLED. IN PAVED AREAS THE SURFACE SHALL BE RESTORED AS SPECIFIED IN SECTION 32 11 00 – SURFACE RESTORATION, TO ALLOW FOR TRAFFIC OVER THE TRENCH DURING NON-WORKING HOURS. UNDER NO CONDITIONS SHALL ANY PIPELINE TRENCH BE LEFT OPEN DURING NON-WORKING HOURS.

3.02 CARBON AND STAINLESS STEEL PIPE

A. Installation of steel pipe shall be by skilled workmen and shall conform to the applicable sections of AWWA Manual M-11. Joints for steel piping shall be either screwed, welded, or flanged as shown on the Drawings or as specified.

B. Welding in the field shall be performed only when requested on the shop drawings and permitted by the Engineer for carbon steel pipe. No welding of stainless steel pipe shall be allowed in the field. All field welds shall be radiographically inspected.

C. Installation of the steel casing pipe shall be by skilled workmen and in accordance with the best standard practice for steel pipe installation. Joints for steel casing pipe shall be butt welded.

1. The boring equipment to be used for installing the jacked casing shall be of such size and capacity to allow the boring to proceed in a safe and expeditious manner. The installation of the casing and boring of the hole shall be done simultaneously to avoid cave-ins or settlement and for safety of traffic above.

2. The Contractor shall check the vertical and horizontal alignment of the casing by survey instrument at least once during each four feet of advance, or as directed by the Engineer. Pits shall be well sheeted and braced as necessary for safe and adequate access for workmen, inspectors and materials and shall be of a size suitable to equipment and material handling requirements.

3. Under no conditions shall jetting or wet boring of encasement under pavement be allowed.

4. After installation of the carrier pipe, each end of the casing pipe shall be made watertight with a brick masonry bulkhead. In addition, a Class B concrete cradle shall be provided from each end of the bulkhead to the first pipe joint outside of the bulkhead.

3.03 JOINTS IN PIPING

A. Restrained joints shall be provided on all pipe joints as specified herein and shown on the Drawings. Restrained joints shall be made up similar to that for push-on joints.

B. Push-on joints include a single rubber gasket which fits into the bell end of the pipe. The gasket shall be wiped clean, flexed and then placed in the socket. Any bulges in the gasket which might interfere with the entry of the plain end of the pipe shall be removed. A thin film of lubricant shall be applied to the gasket surface which will come into contact with the spigot end of the pipe. The lubricant shall be furnished by the pipe manufacturer. The plain end of the pipe, which is tapered for ease of assembly, shall be wiped clean and a thick film of lubricant applied to the outside. The pipe shall be aligned and carefully entered into the socket until it just makes contact with the gasket. The joint assembly shall be completed by entering the pipe past the gasket until it makes contact with the bottom of the socket. The pipe shall be pulled "home" with an approved jack assembly as recommended by the pipe manufacturer. If assembly is not accomplished by reasonable force, the plain end shall be removed, and the condition corrected.

C. Flanged joints shall be brought to exact alignment and all gaskets and bolts or studs inserted in their proper places. Bolts or studs shall be uniformly tightened around the joints. Where stud bolts are used, the bolts shall be uniformly centered in the connections and equal pressure applied to each nut on the stud. Pipes in all lines subject to temperature changes shall be cut short and cold sprung into place to compensate for expansion when hot.

D. Mechanical joints shall be made up with gaskets, glands and bolts. When a joint is to be made up, the bell or socket and plain end shall be cleaned and washed with a solution of mild soap in water; the gland and gasket shall be slid onto the plain end and the end then entered into the socket until it is fully "home" on the centering ring. The gasket shall then be painted with soapy water and slid into position, followed by the gland. All bolts shall be inserted and made up hand tight and then tightened alternately to bring the gland into position evenly. Excessive tightening of the bolts shall be avoided. All nuts shall be pulled up using a torque wrench which will not permit unequal stresses in the bolts. Torque shall not exceed the recommendations of the manufacturer of the pipe and bolts for the various sizes. Care shall be taken to assure that the pipe remains fully "home" while the joint is being made. Joints shall conform to the applicable AWWA Specifications.

E. Threaded and/or screwed joints shall have long tapered full depth threads to be made with the appropriate paste or jointing compound, depending on the type of fluid to be processed through the pipe. All pipe up to, and including 1-1/2-inches, shall be reamed to remove burr and stood on end and well pounded to remove scale and dirt. Wrenches on valves and fittings shall be applied directly over the joint being tightened. Not more than three pipe threads shall be exposed at each connection. Pipe, in all lines subject to temperature changes shall be cut short and cold sprung into place to compensate for expansion when hot. Joints in all piping used for chlorine gas lines shall be made up with a glycerine and litharge cement. Joints in plastic piping (PVC/CPVC) shall be laid and joints made with compounds recommended by the manufacturer. Installation shall conform to the requirements of ASTM D2774 and ASTM D2855. Unions required adjacent to valves and equipment.

F. Soldered joints shall have the burrs removed and both the outside of pipe and the inside of fittings shall be thoroughly cleaned by proper tools recommended for that purpose. Flux shall be applied to both pipe and inside of fittings and the pipe placed into fittings and rotated to insure equal distribution of flux. Joints shall be heated and solder-applied until it shows uniformly around the end of joints between fitting and pipe. All joints shall be allowed to self-cool to prevent the chilling of solder. Combination flux and solder paste manufactured by a reputable manufacturer is acceptable. Unions required adjacent to valves and equipment.

G. Welded joints shall be made by competent operators in a first-class workmanlike manner, in complete accordance with ANSI B31.1 and AWWA C206. Welding electrodes shall conform to ASTM A233, and welding rod shall conform to ASTM A251. Only skilled welders capable of meeting the qualification tests for the type of welding which they are performing shall be employed. Tests, if so required, shall be made at the expense of the Contractor, if so ordered by the Engineer. Unions shall be required adjacent to valves and equipment.

H. Copper joints shall be thoroughly cleaned and the end of pipes uniformly flared by a suitable tool to the bevels of the fittings used. Wrenches shall be applied to the bodies of fittings where the joint is being made and in no case to a joint previously made. Dimensions of tubing and copper piping shall be in complete accordance with the fittings used. No flare joints shall be made on piping not suited for flare joints. Installations for propane gas shall be in accordance with NFPA 54 and/or 58.

I. Solvent or adhesive welded joints in plastic piping shall be accomplished in strict accordance with the pipe manufacturer's recommendations, including necessary field cuttings, sanding of pipe ends, joint support during setting period, etc. Care shall be taken that no droppings or deposits of adhesive or material remain inside the assembled piping. Solvent or adhesive material shall be compatible with the pipe itself, being a product approved by the pipe manufacturer. Unions are required adjacent to valves and equipment. Sleeve-type expansion joints shall be supplied in exposed piping to permit 1-inch minimum of expansion per 100 feet of pipe length.

J. Dielectric isolation such as flange isolation kits, dielectric unions, or similar, shall be installed wherever dissimilar metals are connected according to the following table.

	Zinc	Galvanized Steel	Aluminum	Cast Iron	Ductile Iron	Mild Steel/ Carbon Steel	Copper	Brass	Stainless Steel
Zinc			●	●	●	●	●	●	●
Galvanized Steel			●	●	●	●	●	●	●
Aluminum	●	●		●	●	●	●	●	●
Cast Iron	●	●	●				●	●	●
Ductile Iron	●	●	●				●	●	●
Mild Steel/ Carbon Steel	●	●	●				●	●	●
Copper	●	●	●	●	●	●			●
Brass	●	●	●	●	●	●			●
Stainless Steel	●	●	●	●	●	●	●	●	

Notes:
● signifies dielectric isolation is required between the two materials noted.
Consult Engineer for items not listed in table.
Provide flange isolation kits for all flanged connections of dissimilar metals and hardware including connections to equipment.
Contractor shall include all isolation descriptions with piping submittals.

K. Eccentric reducers shall be installed where air or water pockets would otherwise occur in mains because of a reduction in pipe size.

L. Joints in polypropylene and polyvinylidene fluoride pipe (PVDF) shall be butt fusion weld. All butt welding shall follow the requirements of ASTM D-2657 and the manufacturer's recommendations.

3.04 FLUSHING AND TESTING

A. All piping shall be properly flushed and tested unless specifically exempted elsewhere in the Specifications or otherwise approved by the Engineer. Air and gas pipelines shall be flushed and tested with compressed air. Polymer piping shall be tested with mineral oil or as recommended by the polymer chemical supplier. All other liquid conveying pipelines shall be flushed and tested with water. The Contractor shall furnish and install all means and apparatus necessary for getting the air or water into the pipeline for flushing and testing including pumps, compressors, gauges, and meters, any necessary

plugs and caps, and any required blow-off piping and fittings, etc., complete with any necessary reaction blocking to prevent pipe movement during the flushing and testing. All pipelines shall be flushed and tested in such lengths or sections as agreed upon among the Owner, Engineer, and Contractor. Test pressures shall be as specified in Section 40 06 20 – Process Pipe, Valve and Gate Schedules and shall be measured at the lowest point of the pipe segment being tested. The Contractor shall give the Owner and Engineer reasonable notice of the time when he intends to test portions of the pipelines. Do not test exterior exposed pipelines if air temperature is expected to fall below 32 degrees F. The Engineer reserves the right, within reason, to request flushing and testing of any section or portion of a pipeline.

B. The Contractor shall provide water for all flushing and testing of liquid conveying pipelines. Raw water or non-potable water may be used for flushing and testing liquid pipelines not connected to the potable water system. Only potable water shall be used for flushing and testing the potable water system.

C. Air and gas piping shall be completely and thoroughly cleaned of all foreign matter, scale, and dirt prior to start-up of the air or gas system.

D. At the conclusion of the installation work, the Contractor shall thoroughly clean all new liquid conveying pipe by flushing with water or other means to remove all dirt, stones, pieces of wood, etc., which may have entered the pipe during the construction period. If after this cleaning any obstructions remain, they shall be corrected by the Contractor, at his own expense, to the satisfaction of the Engineer. Liquid conveying pipelines shall be flushed at the rate of at least 5.0 feet per second for a duration suitable to the Engineer or shall be flushed by other methods approved by the Engineer.

E. Compressed/service air and gas piping shall be flushed by removing end caps from the distribution lines and operating one (1) compressor, in accordance with the manufacturer's instructions.

F. After flushing, all air piping shall be pressure and leak tested prior to coating and wrapping of welded joints. Immediately upon successful completion of the pressure and leak test, welded joints shall be thoroughly cleaned of all foreign matter, scale, rust, and discoloration and coated in accordance with the Specifications.

G. All process air piping shall be leak tested by applying a soap solution to each joint. Leak tests shall be conducted with one (1) blower in service at normal operating pressure.

H. During testing the piping shall show no leakage. Any leaks or defective piping disclosed by the leakage test shall be repaired or replaced by the Contractor, at his own expense, and the test repeated until all such piping shows tight.

I. All buried process air piping shall be pressurized to 25 psig and tested for leaks by applying a soap solution to each joint. The air supply shall be stopped and the pipe pressure monitored. System pressure shall not fall by more than 0.5% of the 25 psig test pressure over a one hour test period. Should the system fail to hold the required

pressure for one hour, the cause shall be determined and corrected and the test repeated until a successful test of the entire system is obtained.

J. Field leakage tests shall be performed for all submerged process air piping. The procedure shall consist of operating the system under clear non-potable water for visual identification of all leaks. All field leakage tests shall be witnessed by the Engineer. All submerged piping shall be installed free of any leaks.

K. After flushing, all liquid conveying pipelines shall be hydrostatically tested at the test pressure specified in the appropriate Piping System Schedule in Section 40 06 20 – Process Pipe, Valve and Gate Schedules. The procedure used for the hydrostatic test shall be in accordance with the requirements of AWWA C600. Each pipeline shall be filled with water for a period of no less than 24 hours and then subjected to the specified test pressure for 2 hours. During this test, exposed piping shall show no leakage. Allowable leakage in buried piping shall be in accordance with AWWA C600.

L. Any leaks or defective pipe disclosed by the hydrostatic test shall be repaired or replaced by the Contractor, at his own expense, and the test repeated until all such piping shows tight.

M. After flushing, all gas piping shall be leak tested in accordance with all local codes and regulations and in conformance with the recommendations or requirements of any National Institute or Association for the specific service application.

3.05 DISINFECTION OF PIPELINES

A. Following acceptable pressure testing, flush and disinfect all sections of the water distribution system and receive approval thereof from the appropriate agencies, prior to placing in service. Do not disinfect exterior exposed pipelines if air temperature is expected to fall below 32 degrees F. Advance notice of 24 hours shall be provided to the Owner and Engineer before disinfecting procedures start. Flushing, disinfection and dichlorination shall be accomplished in accordance with the applicable provisions of AWWA Standard C651, "Disinfecting Water Mains" and all appropriate approval agencies.

B. Administration shall be by any of the several methods described in AWWA Standard C651 and as proposed by the Contractor and approved by the Owner and Engineer. Contractor shall submit a proposal describing the desired disinfection method, which shall be approved by the Owner and Engineer prior to commencement of the disinfection process.

C. The initial chlorine dose shall be as described in AWWA C651 for the selected disinfection method. Chlorinated water must be retained in the pipeline long enough to destroy all non-spore forming bacteria, and not less than the retention time recommended for the selected disinfection method per AWWA C651. After the chlorine treated water has been retained for the required time, the chlorine residual at the pipe

extremities and at other representative locations shall be as described in AWWA C651 for the selected disinfection method.

D. During the period that the chlorine solution or slug is in the section of pipeline, valves shall be opened and closed to obtain a chlorine residual at hydrants and other pipeline appurtenances. Care shall be taken to ensure that no chlorinated water enters any active pipeline.

E. Following contact with chlorine solution, the system shall be thoroughly flushed out per Section 4.9 of AWWA C651. All highly chlorinated water shall be flushed out within 72 hours of filling the main with highly chlorinated water. Samples shall then be taken using sterile containers obtained from the local regulatory agency. Samples shall be taken by the Contractor and delivered to the local regulatory agency or approved laboratory for analysis at the Contractor's expense.

F. If samples test positive for coliform organisms, the disinfection procedure shall be repeated until two series of satisfactory samples are obtained, the period between such series of samples to be a minimum of 24 hours. Contractor is responsible for all costs associated with repeat tests. The Contractor shall obtain certificates of satisfactory bacteriological tests and furnish them to the Owner before the request is made for acceptance of the work. Bacteriological testing shall conform to Section 5 of AWWA C651.

G. Chlorine residual tests will be performed after flushing to assure that residual is no higher than what is acceptable to the Owner based on the normal prevailing residual in the drinking water distribution system. Testing shall be performed at multiple locations throughout the piping system to verify residual values.

H. Following disinfection, pipelines and appurtenances shall remain isolated from any operational water system facilities until evidence has been submitted to Owner demonstrating that the pipelines and appurtenances have been adequately and properly disinfected. Normally, pipelines and appurtenances shall be isolated for at least 48 hours, unless a longer period is dictated by the Owner.

I. Sanitary construction methods must be followed during installation of the final connections so no contamination of the new or existing water main with foreign material or groundwater occurs. Materials used for final connections shall be disinfected in accordance with Section 4.10 of AWWA C651.

J. All water used in testing and disinfecting the portions of pipeline, including that used for retesting, shall be disposed of following such testing, retesting, and disinfecting, by the Contractor at its own expense. If required by any agency having jurisdiction, the Contractor shall apply a reducing agent to the solution to neutralize residual chlorine or chloramines remaining in the water prior to discharge. The disposal of water shall, in all cases, be carried out in strict observance of the water pollution control requirements of the local and state regulatory agencies. The flow of water from the portions of the

pipeline shall be controlled to prevent erosion of surrounding soil, damage to vegetation, and altering of ecological conditions in the area.

3.06 PAINTING AND COLOR-CODING SYSTEM

A. All exposed piping specified shall be color coded in accordance with the Owner's standard color designation system for pipe recognition and in accordance with Section 40 05 97 – Piping and Equipment Identification Systems. In the absence of a standard color designation system, the Engineer will establish a standard color designation for each piping service category from color charts submitted by the Contractor in compliance with Section 09 90 00 – Painting.

B. Color Coding for Water mains:

1. All pipe used for water main applications shall be color-coded blue in accordance with FAC 62-555.320(21)(b)(3).

2. Continuous blue stripes, parallel to the axis of the pipe, shall be applied using tape or paint applied to the dry pipe exterior surface.

3. Pipe striped during manufacture shall have stripes applied at 90 degree intervals around the pipe that remain intact following installation of the pipe.

4. Pipe striped during installation shall be in a continuous line along the top of the pipe. Pipes 24 inches and greater shall have two additional stripes on each side.

5. Aboveground water main piping shall be color-coded or marked similar to underground piping.

C. All piping specified in this Section shall be painted in accordance with Section 09 90 00 – Painting, except as follows:

1. Copper pipe

2. Stainless steel pipe. Flanges and supports or hangers shall be painted.

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SECTION 40 05 07
PIPE SUPPORTS

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. Furnish all equipment, labor, materials, and design calculations required to provide pipe supports in accordance with the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01 73 23 – Anchorage and Bracing of Non-Structural Components

B. Division 03 – Concrete

C. Section 05 05 13 – Galvanizing

D. Section 05 05 23 – Metal Fastening

E. Section 05 10 00 – Metal Materials

F. Section 05 12 00 – Structural Steel

G. Section 05 13 00 – Stainless Steel

H. Section 05 50 00 – Metal Fabrications

I. Section 40 05 00 – Basic Mechanical Requirements

1.03 SUBMITTALS

A. Pipe support submittals will not be reviewed prior to review and acceptance of pipe layout submittal. Pipe support submittal shall be fully coordinated with approved pipe layout submittal. Contractor shall use approved piping layout submittal drawings to show proposed pipe support type and location with accurate dimensions to demonstrate that supports meet all specified requirements.

B. Applicable and associated cut sheets and drawings for materials and support components shall be submitted with the Shop Drawings in accordance with or in addition to the submittal requirements specified in Section 01 33 00 – Submittals, Section 40 05 00 – Basic Mechanical Requirements and other referenced Sections above.

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1. Catalog cut information on all system components such as pipe supports, hangers, guides, anchors, and channel-type supports.

2. Drawings of the piping support systems, locating each support, brace, hanger, guide, component and anchor. Identify support, hanger, guide and anchor type by catalog number and Shop Drawing detail number.

3. With each piping support system Shop Drawing, the Contractor shall attach calculations prepared and sealed by a Professional Engineer, licensed in the State or Commonwealth in which the project is located, showing that the piping support system complies with the specified requirements, including all building code and seismic code requirements pertaining to support of piping and other non-structural components. See Section 01 73 23 – Anchorage and Bracing of Non-Structural Components.

4. Table showing the manufacturer's recommended hanger support spacing for PVC, CPVC and FRP pipe for the services listed in Section 40 06 20 – Process Pipe, Valve and Gate Schedules.

PART 2 – PRODUCTS

2.01 GENERAL

A. The Contractor shall be responsible for the design of all piping support systems unless noted otherwise herein. The absence of pipe supports and details on the Drawings shall not relieve the Contractor of the responsibility of providing a pipe support design sealed by a Professional Engineer, licensed in the State or Commonwealth in which the project is located. Standard details for pipe supports have been included on the Drawings to define minimum requirements as to the types of Contractor designed pipe supports that will be acceptable.

B. Where a specific location or type of support is shown on the Drawings, the location and type shall be incorporated in the Contractor's pipe support design.

C. Where special pipe support fabrications are required, products and execution shall be as specified in Section 05 50 00 – Metal Fabrications and other related and referenced Sections of the Specifications.

D. Existing piping support systems to support new piping shall only be used if the Contractor can show and demonstrate by submitting supporting calculations that they are adequate for the additional load imposed by the new piping, or if they are strengthened to support the additional load.

E. Contractor's pipe support design should include, but not be limited to, the following criteria and loads imposed on the piping system:

1. Thrust Loads based on the design pressures as specified in Piping Schedules in Section 40 06 20 – Process Pipe, Valve and Gate Schedules. Pipe support design shall not utilize process equipment for thrust restraint or support of piping loads.

2. Dead loads and live loads per the latest version of ASCE/SEI 7 or the local building code if more stringent. Loads shall include, but not be limited to, the following:

    a. Weight of pipe

    b. Weight of pipe contents

    c. Weight of insulation

    d. Ice loads (If applicable by location, ice loads per code shall be applied as indicated in the governing building code)

    e. Seismic loading requirements and conditions as specified in the governing building code and referenced seismic design codes. Refer to Section 01 73 23 – Anchorage and Bracing of Non-Structural Components and the structural code drawing for project specific seismic design criteria. Seismic and sway bracing shall be provided at maximum 10-foot centers.

    f. Wind loads

3. Loads associated with thermal expansion and contraction of the piping system over the full range of potential temperatures the piping system could experience that should include, but not be limited to, the following:

    a. Ambient temperature range per local historical weather data (historic high and low obtained from NOAA)

    b. Process operating temperature range

    c. Exposure to sunlight where applicable

4. Additional pipe support design considerations shall include the following:

    a. A minimum safety factor of 2 or as approved by the Engineer, based upon the yield strength of the support material, shall be used for pipe supports, braces, hangers, and guides as well as for beam and column members used in channel-type support systems.

    b. The horizontal pipe hanger and/or floor support spacing shall be as recommended by the pipe and/or hanger manufacturer but shall not exceed 10 feet on center unless indicated otherwise herein or on the Drawings.

c. The design, sizing and spacing of anchor bolts, including concrete anchors, shall be based on withstanding shear and pullout loads imposed by loading at each particular support. The minimum anchor bolt size shall be ½ inches in diameter. Refer to Section 05 05 23 – Metal Fastening.

2.02 HANGERS AND SUPPORTS

A. All piping shall be adequately supported and braced by means of steel hangers and/or supports, concrete piers, supplemental lateral bracing components, pre-fabricated brackets, or otherwise as may be required by the location and forces applied per governing code, including gravity and lateral forces from earthquake and/or wind (if outdoors). Generally, concrete supports shall be used where pipe centerline is less than 3 feet above floor, and hangers above 6 feet unless specified or shown otherwise. Supports shall be not more than 10 feet on center for steel and cast iron, 5 feet on center for plastic unless otherwise shown on the Drawings or required by the specific manufacturer. All necessary inserts or appurtenances shall be furnished and installed in the concrete or structures for adequately securing hangers and supports to the structure. Refer to Standard Detail Drawings.

1. Metal pipe support materials, where stainless steel pipe is supported, shall be Type 316L stainless steel meeting the requirements of Section 05 13 00 – Stainless Steel.

2. Metal pipe support materials, where carbon steel, ductile or other ferrous pipe is supported, shall be galvanized carbon steel meeting Section 05 12 00 – Structural Steel and Section 05 05 13 – Galvanizing unless indicated otherwise on the Drawings or in the Specifications or by the Engineer.

3. Metal pipe supports indicated as standard type pipe hangers are designed and detailed for gravity loading only. Resulting lateral loads from wind, earthquake, or other lateral loads per code, or special loading conditions during construction, shall be applied to the pipe in accordance with the governing building code. Supplemental lateral stiffening members (when necessary) shall be provided along pipe or at gravity supports using appropriate supplemental members and connections when required by calculations. The Contractor shall include design calculations and details with all pipe hangar and support submissions for review by the Engineer. The main structure and structural components that will support the pipe hangers and other appurtenant components of the facility have been designed to resist all resulting secondary lateral loading from pipe hangers and other non-structural members for gravity and resulting lateral loads.

B. Hangers and supports shall conform to the following requirements:

1. All fabricated metal hangers and supports shall be capable of adjustment after installation. Different types of hangers and supports along a pipe length, including bends, shall be kept to a minimum.

2. Hanger rods shall be straight and vertical. Chain, wire, strap, or perforated bar hangers shall not be used. Hangers shall not be suspended from other piping.

3. Vertical piping shall be properly supported at each floor and between floors by stays or braces to prevent rattling and vibration.

4. Supports and hangers for plastic and FRP piping shall include wide saddles or bands as recommended by the manufacturer and approved by the Engineer to distribute load and thus avoid localized deformation of the pipe.

5. Hanger and supports shall prevent contact between dissimilar metals by use of copper plated, rubber, vinyl coated or stainless-steel hangers.

6. Ferrous pipes to be painted shall be painted in accordance with Section 09 90 00 – Painting. Ferrous pipes that require painting or galvanizing shall be supported by galvanized hangers and supports. Stainless steel piping shall be supported by stainless steel saddles and straps (if required).

7. Copper piping shall be supported by plastic coated or copper plated steel hangers and supports.

8. Plastic piping shall be supported by plastic coated steel hangers and supports.

9. Hangers and supports shall provide for thermal expansion throughout the full operating temperature range.

10. Expansion and adhesive type anchors used for pipe hangers and supports shall be Type 316 stainless steel.

C. Metallic hangers and supports may be standard make by Anvil International, Inc., "Witch" by Carpenter & Paterson, Ltd., B-Line Systems, Inc., or equal; and data on the types and sizes to be used shall be furnished to the Engineer for approval. Metallic support system brackets, rods, support clips, clevis hangers, hardware, etc. shall be cast iron or welded steel construction. All gravity type hangers and supports shall be restrained laterally to resist seismic loading and other loading as required by the governing code.

D. NON-METALLIC SUPPORT SYSTEM SHALL BE USED IN CHEMICAL PIPING AREAS AND SHALL BE A HEAVY-DUTY CHANNEL FRAMING SYSTEM. Channel frames shall be manufactured by the pultrusion process using corrosion grade polyester or vinylester resins. All fiberglass construction shall include suitable ultraviolet inhibitors for UV exposure and shall have a flame spread rating of 25 or less per ASTM E84. Piping accessories, pipe clamps, clevis hangers, support posts, support racks, fasteners, etc., shall be constructed of vinylester or polyurethane resin. Non-metallic support systems shall be standard make Aickinstrut by Aickinstrut, Inc., Unistrut Fiberglass by Unistrut, Inc., Enduro Fiberglass Systems, or equal. The Contractor shall submit data on the types and sizes of approval. Unless otherwise shown or specified the Contractor shall

provide support spacings in the conformance with the pipe and support system manufacturer's requirements.

PART 3 – EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

A. Support piping connections to equipment by pipe support and not by the equipment.

B. Support large or heavy valves, fittings, flow meters and appurtenances independently of the connected piping.

C. Support no pipe from the pipe above it.

D. Support piping at changes in direction or in elevation, adjacent to flexible joints, expansion joints, and couplings, and where shown.

E. The Contractor shall not install piping supports and hangers in equipment access areas or bridge crane runs.

F. Brace hanging pipes against horizontal movement by both longitudinal and lateral sway bracing.

G. Install pipe anchors (fixed supports and/or guides) where shown and/or as may otherwise be required to withstand expansion thrust loads and to direct and control thermal expansion. The Contractor may install additional pipe anchors and flexible couplings to facilitate piping installation, provided that complete details describing location, pipe supports and hydraulic thrust protection are submitted.

END OF SECTION

SECTION 40 05 19
DUCTILE IRON PIPE

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. Reference Section 09 90 00 – Painting.

B. Reference Section 40 05 00 – Basic Mechanical Requirements

C. Reference Section 40 06 20 – Process Pipe, Valve, and Gate Schedules, for pressure rating requirements for specific applications.

1.02 SUBMITTALS

A. Submittals shall be provided in accordance with Section 01 33 00 – Submittal Procedures.

B. The Contractor shall submit a certificate from the Manufacturer stating that all linings have been provided in accordance with the specification requirements herein.

PART 2 – PRODUCT

2.01 DUCTILE IRON PIPE AND FITTINGS

A. All ductile iron pipe and specials shall be marked with the manufacturer's name or trademark, size, weight, thickness class, the date of manufacture, and the word "Ductile".

B. Ductile iron pipe of the sizes shown or specified shall conform to AWWA C151/A21.51, Grade 60-42-10 for ductile iron pipe centrifugally cast in metal molds or sand-lined molds.

C. Ductile iron pipe shall conform to AWWA C150/A21.50 for thickness design and shall be supplied in 18-foot or 20-foot nominal lengths or as required to meet the requirements of the Drawings.

D. Fittings and specials shall be cast iron or ductile iron and conform to the requirements of AWWA C110/A21.10 and AWWA C153/A21.53.

E. Minimum Class 53 pipe shall be used for flanged spools.

F. Ductile iron pipe spools that are to be field cut shall be marked “Gaged Full Length”.

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2.02 PIPE COATINGS

A. All buried ductile iron pipe and fittings shall have a bituminous coating of standard thickness on the exterior surfaces in accordance with AWWA C151/A21.51.

B. All exposed ductile iron pipe and fittings shall have a shop-applied prime coat in accordance with Section 09 90 00 – Painting.

2.03 PIPE LININGS

A. All pipe and fittings, with the exception of epoxy and glass lined pipe and sleeves, shall be cement mortar lined. Cement mortar linings shall conform to American Standard Specifications for Cement Mortar Lining for Cast Iron Pipe and Ductile Iron Pipe and Fittings, AWWA C104/A21.4 and shall be standard thickness. The mortar lining shall be protected with a bituminous seal coat.

B. Epoxy-Lined Pipe (Not Used)

C. Glass-Lined Pipe (Not Used)

D. Fusion-Bonded Epoxy Lined and Coated-Pipe (FBEL&C) (Not Used)

2.04 PIPE JOINTS

A. Requirements for various types of joints are described in the following paragraphs. UNLESS OTHERWISE NOTED HEREIN OR ON THE DRAWINGS, ALL EXPOSED DUCTILE IRON PIPING SHALL HAVE FLANGED JOINTS.

B. Flanged Joints

1. Flanged joints and fittings shall have a minimum pressure rating of 250 psi with 125 lb. American Standard flanges.

2. All flanges and fittings shall conform to the requirements of ASME B16.1.

3. Flanges shall be ductile iron and shall be of the threaded or screw on type.

4. The face of the flanges shall be machined after installation of the flange to the pipe. No raised surface shall be allowed on flanges.

5. Flanged pipe shall conform to the requirements of AWWA C115/A21.15.

6. Pipe lengths shall be fabricated to meet the requirements of the Drawings.

7. Gaskets shall be Toroseal by American Cast Iron Pipe Company, Flange-Tyte by US Pipe, or equal. Gaskets shall be full-face, 1/8-inch minimum thickness cloth inserted rubber, red rubber, neoprene, or superior elastomer and shall be compatible with the fluid being conveyed. Gaskets shall have an allowable

maximum working pressure and temperature equal to or greater than the service in which it is installed.

8. Bolts shall be of the size and length called for and in accordance with the "American Standard" and comply with the requirements of the ANSI/AWWA Standards. Bolts used for exposed flanged joints shall be a minimum ASTM A307, Grade B carbon steel, and be in accordance with AWWA C110/A21.10. Bolts used for flanged joints in submerged applications shall be Type 316 stainless steel and installed with dielectric isolation flange kits and anti-seize. All bolts shall have hexagonal heads and nuts of the same material as the bolt. No washers shall be used.

C. Bell and Spigot Joints

1. Bell and spigot pipe shall be provided with push on, O-ring rubber gasket, compression type joints and shall conform to the requirements of AWWA C111/A21.11. Fittings and specials shall be supplied with mechanical joints as specified for mechanical joint pipe. If required by installation conditions, pipe shall have caston lugs for adequately tying it together.

D. Mechanical Joints

1. Mechanical joints and fittings shall conform to the requirements of AWWA C111/A21.11. Joints shall be made employing a tapered rubber gasket forced into a tapered groove with a ductile iron follower ring. If required by installation conditions, pipe and fittings shall have caston lugs for adequately tying the pipe and fittings together. These shall be in conformance with standard practice and as outlined under the appropriate AWWA Specifications.

2. Bolts for mechanical joints shall be high-strength low-alloy steel tee-head bolts with hexagonal nuts per AWWA C111/A21.11, both coated using a three-layer system consisting of a metallic base coat, an adhesion coat, and a heat cured fluoropolymer compound containing PTFE as topcoat.

E. Grooved End Joints

1. Grooved coupling joint pipe and fittings shall be split type, shouldered end. Coupling materials shall be malleable iron. Couplings shall have a minimum pressure rating and service equal to that of the connected piping.

2. Gaskets shall be of rubber.

3. After installation, buried couplings shall receive two heavy coats of coal tar epoxy (min. 24 mil thickness) which is compatible with the finish of the couplings.

4. Couplings shall be as manufactured by Victaulic Company of America Style 31, or equal.

F. Restrained Joints

1. Restrained joint pipe shall consist of factory manufactured bolted retainer rings, ductile iron locking segments held in place by rubber retainers, or ductile iron retaining rings that lock over the bell of the joint and are secured to prevent rotation, and factory welded retainer beads or rings on the spigot of the pipe. All components of the bolted or snap ring assemblies shall be constructed of corrosion-resistant, high strength, low-alloy steel coated using a three-layer system consisting of a metallic base coat, an adhesion coat, and a heat cured fluoropolymer compound containing PTFE as topcoat.

2. Restrained joint pipe shall be Flex-Ring or Lock-Ring type joints as manufactured by American Cast Iron Pipe Company, HP LOK or TR Flex as manufactured by US Pipe, Bolt-Lok or Snap-Lok as manufactured by Griffin Pipe Products, TR Flex or Super Lock as manufactured by Clow Water Systems Co., or approved equal.

3. Restrained fittings for piping systems 16-inches in diameter and greater shall have factory restraint systems identical to the factory restrained joint pipe specified above. All fittings shall be minimum pressure Class 250 unless otherwise specified.

4. Restrained fittings for pipe systems 14-inches in diameter and smaller shall be Mechanical Joint fittings with restraint assemblies such as Stargrip by Star Pipe Systems, Mega Lug by EBAA Iron, ONE LOK by Sigma, Grip Ring by Romac, or approved equal. Restraint assemblies including all hardware shall be painted with two heavy coats of coal tar epoxy after installation. Where threaded-rods are allowed, the rods and tabs shall be designed for the specified restraint system design pressure, shall have lengths less than 10 feet between fittings, and shall be painted with two heavy coats of coal tar epoxy after installation.

5. The manufactured systems for thrust restraint indicated above shall be used where restrained joint ductile iron pipe and fittings are specified or indicated on the drawings. Gripping gaskets are not an acceptable form of restraint. Thrust restraint and harnessing systems such as threaded-rods, friction clamps, retainer glands shall be used only where specifically specified herein, indicated on the drawings or if allowed by the Engineer in isolated applications where conditions warrant and necessitate their use. Concrete thrust blocks may be used in accordance with the schedule indicated on the drawings, if applicable.

2.05 OUTLETS

A. The Contractor shall utilize tapping saddles or tapping sleeves at outlet location in accordance with Section 40 05 00 – Basic Mechanical Requirements for requirements.

2.06 POLYETHYLENE ENCASEMENT

A. Wrap all buried ductile iron pipes, valves and fittings with 8 mil polyethylene film per ANSI A21.5/AWWA C-105. Use only tube type for pipe. Complete the wrap prior to placing concrete anchors, collars, supports or thrust blocks. Repair polyethylene if damaged during installation.

2.07 CAST IRON SOIL PIPE

A. Cast Iron Soil Pipe shall conform to the standards of the Cast Iron Soil Pipe Institute (CISPI) Specification HS-67, and also ANSI Specification A-112.5.2 for Hub & Spigot pipe or A.112.5.1 for Hub & Spigot pipe or A.112.5.1 for No-Hub Pipe. Pipe class shall be "Extra Heavy:(XH).

END OF SECTION

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SECTION 40 05 31

PVC/CPVC PIPE

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. Reference Section 40 05 00 – Basic Mechanical Requirements.

PART 2 – PRODUCTS

2.01 POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS

A. PVC pipe and fittings shall be manufactured in accordance with ASTM D1785, D1784 and F441, "normal impact" pipe, Schedule 40 or 80 as specified.

B. Fittings used with this pipe shall be socket type or flanged type as specified herein, in Section 40 06 20 – Process Pipe, Valve, and Gate Schedules, or indicated on the Drawings. Plastic piping shall be installed in full accordance with the manufacturer's recommendations for the specific installation. No field bending or distortion of the pipe will be permitted.

C. PVC pipe shall be Type 1 Grade 1 conforming to ASTM D1784 and D1785. Fittings shall conform to the following standard specifications:

1. Socket Type: (Schedule 40); ASTM D2466

2. Socket Type: (Schedule 80); ASTM D2467

D. Provide flanged fittings of the same material as the specified pipe and material conforming to ANSI B16.5 at all valves and equipment except at true (double) union valves. Flange gaskets shall be natural rubber or other material fully compatible with the fluid being conveyed. Where flanged piping is used with chemical systems, the gasket material shall conform to the requirements of the following table. Flange bolts shall be type 316 stainless steel minimum, with higher grade materials used where necessary for fluid (chemical) compatibility.

Chemical	Elastomer Material
Chlorine Solution (from gas)	FKM
Sodium Hypochlorite	FKM

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E. Acceptable materials of construction of elastomers for non-chemical service shall be as follows:

Non-Chemical Service	Elastomer Material
Non-Potable Water	EPDM
Process Drain (Gravity)	EPDM, FKM
Process Drain (Pressure)	EPDM, FKM
Potable Water	EPDM
Reclaimed Water	EPDM, FKM
Sample	EPDM, FKM
Sump Pump Discharge	EPDM, FKM

F. Solvent cement for socket type joints shall conform to ASTM D2564 for PVC pipe and fittings. Solvent cement for chemical service shall be Weld-On 724 as manufactured by IPS Corporation, or equal. All chemical pipe solvent weld joints shall be primed with Weld-On® P-70.

G. PVC C900 PC 235 (DR18) shall be in sizes between 4 inches and 18 inches and shall meet the requirements of AWWA C900 "Poly Vinyl Chlorine (PVC) Pressure Pipe" and shall conform to all the requirements of ASTM D1784 and ASTM D2241. The pipe shall be capable of withstanding the overburden pressures determined by the depth of burial in the field.

1. Pipe material shall be made from clean, virgin, NSF approved Class 12454-A PVC compound conforming to resin specification ASTM D1784. Standard laying lengths shall be 20-feet (±1 inch). Random lengths of not more than 15% of the total footage of each size may be shipped in lieu of the standard lengths. Reruns of reclaimed material shall not be accepted.

2. The pipe shall have bell and spigot ends with push-on, O-ring rubber gasket, compression type joints conforming to the requirements of ASTM D2672. Elastomeric gaskets shall conform to the requirements of ASTM F477.

3. Minimum pipe stiffness (F/dY) at 5% deflection shall be 435 psi for all sizes when tested in accordance with D2241.

4. The pipe shall be designed to pass a quick burst test pressure of 755 psi applied in 60 to 70 seconds when tested in accordance with ASTM D1599, as referenced in ASTM D2241.

5. Fittings for PVC C900 PC235 (DR 18) pipe shall be ductile iron, bolted mechanical joint.

2.02 CHLORINATED POLYVINYL CHLORIDE (CPVC) PIPE AND FITTINGS

A. CPVC shall be manufactured in accordance with ASTM D1785, D1784 and F441, "normal impact" pipe, Schedule 40 or 80 as specified.

B. Fittings used with this pipe shall be socket type or flanged type as specified herein or indicated on the Drawings. Plastic piping shall be installed in full accordance with the manufacturer's recommendations for the specific installation. No field bending or distortion of the pipe will be permitted.

C. CPVC pipe shall be Type 4, Grade 1, Schedule 80, conforming to ASTM D1784 and ASTM F441. CPVC fittings shall be socket type conforming to ASTM F439.

D. Solvent cement for socket type joints shall conform to ASTM F493 for CPVC pipe and fittings. Solvent cement for chemical service shall be Weld-On 724 as manufactured by IPS Corporation, or equal.

2.03 REINFORCED THERMOPLASTIC HOSE AND FITTINGS

A. Reinforced thermoplastic hose shall be clear type, reinforced with polyester yarn. Hose material shall be PVC, EVA (Ethyl Vinyl Acetate), or Low-Density Polyethylene, depending on the application, as indicated in Section 40 06 20 – Process Pipe, Valve, and Gate Schedules. Hose shall be rated for the following working pressures:

Internal Diameter	Minimum Working Pressure at 73°F (at 100°F)
¼”	200 psi (180 psi)
⅜"	150 psi (125 psi)
½”	150 psi (125 psi)
¾”	125 psi (100 psi)
1”	100 psi (85 psi)

B. Hoses shall be continuous from the source to the discharge unless shown otherwise on the drawings. Splices shall not be allowed unless approved in writing by the Engineer. If allowed, splices shall occur only in handholes or manholes. Connections and splices, if allowed, shall be barb and clamp type using materials that are compatible with the chemical being conveyed.

C. Reinforced thermoplastic hose shall be a manufactured product of Parker Nexgen, Saint Gobain Tygon Series, or equal.

D. Wetted materials shall be completely resistant to corrosion by the specified chemicals. Hose manufacturer shall guarantee that the hose is suitable for the intended service.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Polyvinyl chloride (PVC), chlorinated polyvinyl chloride (CPVC) and High Density Polyethylene (HDPE) pipe shall be laid and joints assembled according to the respective manufacturer's recommendation. PVC pipe installation shall comply with applicable sections of the Uni-Bell PVC Pipe Association Recommended Standard Specifications.

B. Plastic piping shall not be installed when the temperature is less than 60 degrees F except as otherwise recommended by the manufacturer and approved by the Engineer.

END OF SECTION

SECTION 40 05 51
VALVES, GENERAL

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish and install, complete with all assemblies and accessories, all valves shown on the Drawings and specified herein including all fittings, appurtenances and transition pieces required for a complete and operable installation.

B. All valves shall be constructed of first quality materials which have strength, wearing, and corrosion resistance characteristics entirely suitable for the types of service for which the individual valves are designated. Except where noted otherwise, valves designated for water service shall conform to pertinent sections of the latest revision of AWWA C500 Specifications. Cast iron valve bodies and parts shall meet the requirements of the latest revision of ASTM Designation A-126, "Standard Specifications for Gray Iron Castings for Valves, Flanges, and Pipe Fittings, Class B."

C. All valve body castings shall be clean, sound, and without defects of any kind. No plugging, welding, or repairing of defects will be allowed.

D. Valves shall have flanged ends for exposed service and mechanical joint ends for buried service, unless otherwise shown on the Drawings or specified herein. Flanged ends shall be flat-faced, 125 lb. American Standard unless otherwise shown or specified in accordance with ANSI B16.1. All bolt heads and nuts shall be hexagonal of American Standard size. The Contractor shall be responsible for coordinating connecting piping. Valves with screwed ends shall be made tight with Teflon tape. Unions are required at all screwed joint valves.

E. Elastomers found in the piping and valves of conveyance systems carrying chloramines-treated water that contact the water shall be made of peroxide-cured EPDM. This requirement supersedes any specified elastomer in the individual pipe and valve specifications exposed to the product for this conveyance application.

1.02 SUBMITTALS

A. The following items shall be submitted in accordance with, or in addition to the submittal requirements specified in Section 01 33 00 – Submittal Procedures and Section 46 00 00 – Equipment General Provisions:

1. Performance tests shall be conducted in accordance with the latest revision of AWWA C500.

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2. Shop Drawings conforming to the requirements of Section 01 33 00 – Submittal Procedures, are required for all valves, and accessories. Submittals shall include all layout dimensions, size and materials of construction for all components, information on support and anchoring where necessary, pneumatic and hydraulic characteristics and complete descriptive information to demonstrate full compliance with the Documents. Shop Drawings for electrically operated/controlled valves shall include all details, notes, and diagrams which clearly identify required coordination with the electrical power supply and remote status and alarm indicating devices. Electrical control schematic diagrams shall be submitted with the Shop Drawings for all electrical controls. Diagrams shall be drawn using a ladder-type format in accordance with JIC standards. Shop Drawings for pneumatically operated/controlled valves shall include all details, notes, and diagrams which clearly identify required coordination with the compressed air (service air) system and electrical controls.

3. Operation and maintenance manuals and installation instructions shall be submitted for all valves and accessories in accordance with the Specifications. The manufacturer(s) shall delete all information which does not apply to the equipment being furnished.

PART 2 – PRODUCTS

2.01 CORPORATION STOPS

A. Corporation stops shall be of bronze with tapered male iron pipe threads on inlets and outlets. Terminal outlets shall have screwed bronze hex head dust plugs or caps. Unions shall be used on all corporation stop outlets with connecting piping. Corporation stops shall have a minimum working pressure rating of 250 psi and shall be as manufactured by Mueller Co., Hays Mfg. Div. of Zurn Industries, or equal.

2.02 FLOOR BOXES

A. Floor boxes shall be provided for all nut operated or floor accessed valves. Floor boxes shall be of the adjustable, sliding type, cast iron, suitable to withstand heavy traffic, as manufactured by James B. Clow & Sons, Kennedy Valve Mfg. Co., or equal. The covers shall be marked with appropriate designations of piping contents (i.e.: water, sewer) and bases shall be the round type. All nut operated valves in this Section shall be clearly identified by stainless steel or laminated plastic identification tags. The tags shall be permanently affixed to the inside of the floor boxes, under grating, etc. and shall bear the embossed letters which clearly identify each valve by its appropriate designation.

B. Two (2) valve operating wrenches shall be supplied in 4-foot lengths with tee handles for each size nut supplied. Valve wrenches shall be Model No. F-2520 as manufactured by James B. Clow & Sons, Kennedy Valve Mfg. Co., Figure No. 122, or equal.

2.03 VALVE BOXES

A. The Contractor shall furnish and install valve boxes as shown on the Drawings and specified herein.

B. All valve boxes shall be placed so as not to transmit shock or stress to the valve and shall be centered and plumb over the operating nut of the valve. The ground in the trench upon which the valve boxes rest shall be thoroughly compacted to prevent settlement. The boxes shall be fitted together securely and set so that the cover is flush with the finished grade of the adjacent surface. A concrete pad as detailed on the Drawings shall be provided around the valve box, sloped outwards.

C. All valve boxes shall be 2-piece cast iron, sliding type, 5-1/4" shaft, with heavy duty traffic weight collar and the lid marked with the appropriate carrier product (i.e.: WATER). Boxes shall be as manufactured by James B. Clow & Sons, Kennedy Valve Mfg. Co., Charlotte Pipe and Foundry Company, or equal.

2.04 STRAINERS

A. Y-Strainers shall be Y-pattern cast iron body, flanged or screwed ends with stainless steel or Monel, 20 mesh strainers. Strainers shall be 200 psi, cold-water service strainers, as manufactured by WATTS, Crane Co., Zurn, or equal.

B. Stainless steel Y-strainers shall be provided as shown on the drawings. Strainers shall be full port-full flow design manufactured of 304 or 316 stainless steel body. Y-strainers shall be furnished with flanged ends. The strainer screen shall be 1/32-inch perforation, easily removable, manufactured of the same material as the valve body.

C. PVC and CPVC Y-strainers shall be provided in PVC and CPVC piping and as shown on the Drawings. Strainer shall be provided with PVC or CPVC body and end cap, EPDM or Viton seal as required for the chemical service, and 20 mesh screen. Temperature rating shall be 30ºF to 140ºF, and pressure rating shall be 150 psi @ 70ºF, non-shock. PVC and CPVC Y-strainers shall be as manufactured by Asahi/America, Hayward, or equal.

D. Manually cleaned strainers shall be the duplex basket tapered plug type.

1. Strainers 3-inches in diameter and larger shall have flanged ends conforming to ANSI B16.1-125/150-pound standard.

2. Strainers less than 3-inches in diameter shall have screwed end connectors, unless otherwise shown on the Drawings.

3. Strainers shall be constructed with an ASTM A48, Class 30 cast iron body, ductile iron trim, removable 0.045-inch staggered hole perforation, 304 stainless steel filter baskets and gauges on the inlet and outlet.

4. All strainers shall be suitable for 125 psi service.

5. Switching flow from one basket to the other shall be accomplished by moving the handle through a 180º arc. The switching operation shall not stop flow through the strainer and shall provide for on-line removal of either basket with the other basket functional. The plug shall be automatically positioned with integral stops and shall be easily lifted and reseated under pressure.

6. The strainer shall be designed to minimize the possibility of material bypassing the plug while being rotated and to prevent debris from building up under the plug. The strainer covers shall be designed for quick opening with swing away yoke.

7. Each basket compartment shall have a side drain outlet.

8. All strainers shall be provided with support legs.

9. Duplex basket strainers shall be similar to the Model 53BTX as manufactured by Eaton, or equal.

E. PVC and CPVC simplex basket strainers shall be provided in PVC and CPVC piping as shown on the Drawings. 1/2”-4” strainers shall be one-piece molded body with (3) ports to facilitate straight-thru flow pattern or u-shape flow pattern as required. Connections shall be true union type to ease installation/future maintenance. The cover, vent plug, and drain plug shall all be hand-removable, requiring no tools. EPDM or Viton seals shall be used as required for chemical service, and internal baskets shall be 1/32” perforation (20-mesh) for 1/2”-1” sizes, and 1/8” perforation for 1-1/2”-8” sizes. 6” and 8” strainers shall be fabricated construction and shall contain flanged connections as standard. The pressure rating for 1/2”-8” sizes shall be 150 psi @ 70ºF, non-shock. Strainers shall be manufactured by Hayward Industrial Products, or equal.

2.05 QUICK DISCONNECT COUPLINGS

A. Quick disconnect type couplings for chemical service lines shall be provided where indicated on the Drawings. Couplings and caps shall be constructed of polypropylene and integral safety lock.

2.06 BACKFLOW PREVENTERS

A. Backflow preventer shall be the size shown on the Drawings and shall be of the double check valve principle. Backflow preventer installation shall include isolation valves and four test cocks, furnished as an assembly. For backflow preventers less than 2-1/2", the installation assembly also shall include a strainer. Isolation valves for backflow preventers shall be ball valves, except for size 2-1/2" and larger which shall be resilient seat gate valves. Test cocks shall be located as recommended by the manufacturer to facilitate functional testing of the assembly. The backflow preventer shall be a WATTS 709, or equal.

B. Reduced Pressure Backflow Preventer shall be of the size shown on the Drawings and shall be of the reduced pressure principle type in accordance with AWWA Standards

C510 and C511, with two (2) independent operating spring loaded check valves and one (1) spring loaded, diaphragm actuated, differential pressure relief valve shall be installed between the check valves. Backflow preventer shall be bronze body construction, with EPT rubber discs and Buna-N and nylon diaphragm. Screws and springs shall be of stainless steel. End connections shall be screwed, unless otherwise specified or shown on the Drawings. Reduced pressure backflow preventer installations shall include isolation valves and four test cocks, furnished as an assembly. For reduced pressure backflow preventers less than 2-1/2" the installation assembly also shall include a strainer. Isolation valves for reduced pressure backflow preventers shall be ball valves, except for sizes 2-1/2" and larger which shall be resilient seat gate valves. Test cocks shall be located as recommended by the manufacturer to facilitate functional testing of the assembly. The reduced pressure backflow preventer shall be as manufactured by Beeco Division, Hersey Products Inc., Aergap Model 6CM, WATTS 909, or equal.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Except where noted otherwise herein, all valves shall be installing and tested in accordance with the latest revision of AWWA C500. Before installation, all valves shall be lubricated, manually opened and closed to check their operation and the interior of the valves shall be thoroughly cleaned. Valves shall be placed in the positions shown on the Drawings. Joints shall be made as directed under the Piping Specifications. The valves shall be so located that they are easily accessible for operating purposes and shall bear no stresses due to loads from the adjacent pipe. The Contractor shall be responsible for coordinating connecting piping.

B. All valves shall be tested at the operating pressures at which the particular line will be used. Any leakage or "sweating" of joints shall be stopped, and all joints shall be tight. All motor operated and cylinder operated valves shall be tested for control operation as directed by the Engineer.

C. Provide valves in quantity, size, and type with all required accessories as shown on the Drawings.

D. Install all valves and appurtenances in accordance with manufacturer's instructions. Install suitable corporation stops at all points shown or required where air binding of pipe lines might occur. Install all valves so that operating handwheels or wrenches may be conveniently turned from operating floor but without interfering with access, and as approved by Engineer. Unless otherwise approved, install all valves plumb and level. Valves shall be installed free from distortion and strain caused by misaligned piping, equipment or other causes.

E. Valve boxes shall be set plumb and centered with the bodies directly over the valves so that traffic loads are not transmitted to the valve. Earth fill shall be carefully tamped

around each valve box to a distance of 4 feet on all sides of the box, or to the undisturbed trench face, if less than 4 feet.

3.02 SHOP AND FIELD TESTING

A. Shop and field testing of valves shall be as follows:

1. Certified factory testing shall be provided for all components of the valve and operator system. Valves and operators shall be shop tested in accordance with the requirements in the latest revision of AWWA C500, including performance tests, leakage test, hydrostatic tests, and proof-of-design tests. The manufacturer through the Contractor shall submit certified copies of the reports covering the test for acceptance by the Engineer.

2. Shop testing shall be provided for the operators consisting of a complete functional check of each unit. Any deficiencies found in shop testing shall be corrected prior to shipment. The system supplier through the Contractor shall submit written certification that shop tests for the electrical/pneumatic system and all controls were successfully conducted and that these components provide the functions specified and required for proper operation of the valve operator system.

3. The Contractor shall conduct field tests to check and adjust system components, and to test and adjust operation of the overall system. Preliminary field tests shall be conducted prior to start-up with final field tests conducted during start-up. The factory service representative shall assist the Contractor during all field testing and prepare a written report describing test methods, and changes made during the testing, and summarizing test results. The service representative shall certify proper operation of the valve operator system upon successful completion of the final acceptance field testing.

4. Preliminary and final field tests shall be conducted at a time approved by the Engineer. The Engineer shall witness all field testing.

5. All costs in connection with field testing of equipment such as energy, light, lubricants, water, instruments, labor, equipment, temporary facilities for test purposes, etc. shall be borne by the Contractor. The Contractor shall be fully responsible for the proper operation of equipment during tests and instruction periods and shall neither have nor make any claim for damage which may occur to equipment prior to the time when the Owner formally takes over the operation thereof.

6. Preliminary field tests shall be conducted prior to start-up and shall include a functional check of the entire valve operator system and all system components. Preliminary field tests shall demonstrate that the valve operator system performs according to specifications and that all equipment, valves, controls, alarms, interlocks, etc., function properly. The preliminary field test report must be approved by the Engineer prior to conducting final field acceptance tests. Based

on results of preliminary field tests, the Contractor shall make any adjustments required to settings, etc., to achieve the required valve closing time and operation specified or otherwise directed by the Engineer.

7. Final field acceptance tests shall be conducted simultaneously with the start-up and field testing of the pumps, air compressors, process air blowers, etc. Field tests shall be conducted for the full range of operating modes and conditions specified and as directed by the Engineer. Each of the valves shall be tested at minimum, maximum, and normal head/flow conditions, and under all specified conditions of opening and closing. Performance of pneumatic valves and compressed air system under normal operating conditions and during simulated power failures shall be checked.

8. Field testing shall include optimization of opening and closing times of the valves. The Contractor shall provide the means for accurate measurement of pipeline pressures as directed by the Engineer. Valve opening and closing times shall be adjusted based on process requirements to optimize operation of the valves. Final valve opening and closing times as determined by field tests shall be approved by the Engineer prior to final acceptance of the system.

END OF SECTION

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SECTION 40 05 57
VALVE OPERATORS

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. Equipment shall be provided in accordance with the requirements of Section 46 00 00 – Equipment General Provisions and Section 40 05 00 – Basic Mechanical Requirements.

B. Reference Section 40 06 20 – Process Pipe, Valve, and Gate Schedules for additional information on valves and operators/actuators.

C. Valve operators and electric valve actuators shall be designed to unseat, open or close, and seat the valve under the most adverse operating condition to which the valves will be subjected.

D. Operator mounting arrangements shall be as indicated on the Drawings or as directed by the manufacturer and/or Engineer. There shall be no mounting restrictions on the electric valve actuator.

E. The valve operators and electric actuators shall be the full and undivided responsibility of the valve manufacturer in order to ensure complete coordination of the components and to provide unit responsibility.

1.02 SUBMITTALS

A. The following items shall be submitted in accordance with, or in addition to the submittal requirements specified in Section 01 33 00 – Submittal Procedures and Section 46 00 00 – Equipment General Provisions:

1. Shop Drawings

2. O&M Manuals

3. Certification that the force required to operate all valves is as specified herein.

PART 2 – PRODUCTS

2.01 GENERAL

A. Manual operators shall be provided on all valves which do not receive electric actuators. Manual operator type shall be as specified herein and as shown on the Drawings.

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B. Quarter turn valves 8” and greater in size shall have geared operators. Gate valves 14” and greater in size shall have geared operators.

C. Operators/actuators shall be furnished with conservatively sized extension bonnets, extension stems, or torque tubes, and all required appurtenances required for a complete installation. Operators furnished with extension bonnets shall include stainless steel extension stems, or stainless steel torque tubes.

2.02 MANUAL OPERATORS

A. Unless otherwise specified or shown on the Drawings, manual operator type shall be as follows:

1. Buried valves shall be equipped with nut operators, extended stems, and valve boxes. Where the depth of the operating nut is more than 4 feet below finish grade, a valve operator extension shall be provided to bring the operating nut to within 18-24 inches of the surface.

2. Exposed valves up to 6-inch shall be lever operated (except gate valves).

3. Exposed valves 8-inches and larger shall be handwheel operated.

4. Exposed gate valves shall be handwheel operated.

5. Valves with centerline of operator located more than 6-feet above the floor or platform from which it is to be operated shall have a chainwheel operator unless otherwise indicated on the Drawings.

B. Manual operators shall be rigidly attached to the valve body unless otherwise specified or shown on the Drawings.

C. All operators shall turn counter-clockwise to open and shall have the open direction clearly and permanently marked.

D. Valve operators shall be designed so that the force required to operate the handwheel, lever, or chain (including breakaway torque requirements) does not exceed 80 pounds applied at the extremity of handwheel or chainwheel operator. Design pressures for sizing of valve operators shall be the piping test pressure for the piping in which the valve is to be installed as shown in the Piping Schedule in Section 40 06 20 – Process Pipe, Valve, and Gate Schedules.

E. Handwheels for valves operators shall not be less than 12 inches in diameter. The maximum diameter of any handwheel shall not exceed 24”.

F. Nut operators shall have standard 2-inch square AWWA operating nuts designed in accordance with AWWA C504-94.

G. Geared manual operators shall be of the worm gear, traveling nut or scotch yolk type except manual operators for butterfly valves 18-inch in diameter or larger which shall be worm gear, unless otherwise indicated in the individual valve specification. Gear operators shall be of the worm gear or bevel gear type. Gear box designs incorporating end of travel stops in the housing shall be equipped with AWWA input stops. Each gearbox shall require a minimum of 10 turns for 90 degree rotation or full valve stem travel and shall be equipped with a mechanical valve position indicator.

H. Manual operators on below grade (and vault installed) valves shall be permanently lubricated and watertight under an external water pressure of 10 psi.

I. Valve operators shall be provided by the following manufacturers and shall be able to mount to valves specified in Section 40 05 68.13 – PVC and CPVC Valves:

1. Asahi/America

2. Nibco/Chemtrol

3. IPEX

4. Hayward Flow Control

5. Plastomatic

PART 3 – EXECUTION

3.01 INSTALLATION

A. All valve actuators shall be installed in accordance with the manufacturer's published recommendations and the applicable Specification Sections for valves and motor controls.

B. Valve actuators shall be factory coated in accordance with the manufacturer’s standard paint system.

3.02 FIELD TESTS

A. Preliminary Field Tests

1. General: Preliminary field tests shall be conducted prior to start-up and shall include a functional check of the entire valve operator system and all system components.

2. Scope: Preliminary field tests shall demonstrate that the valve operator system performs according to specifications and that all equipment, valves, controls, alarms, interlocks, etc., function properly.

3. Based on results of preliminary field tests, the Contractor shall make any adjustments required to settings, etc., to achieve the required valve closing time and operation, as specified or otherwise directed.

B. Final Field Tests

1. Final field tests shall be conducted in accordance with the latest revision of AWWA C500.

2. Final field tests shall be conducted simultaneously with the start-up and field testing of the pumps.

3. Final field tests shall be conducted for the full range of operating modes and conditions specified and as directed by the Engineer. Each of the valves shall be tested at minimum, maximum, and normal head/flow conditions, and under all specified conditions of opening and closing.

4. Certification of Equipment Compliance: After the final field tests are completed and passed, submit affidavit according to Section 46 00 00 – Equipment and General Provisions.

END OF SECTION

SECTION 40 05 61

GATE VALVES

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. Reference Section 40 05 00 – Basic Mechanical Requirements.

B. The Contractor shall furnish and install, complete with all assemblies and accessories, all gate valves shown on the Drawings, specified herein and as specified in Section 40 06 20 – Process Pipe, Valve, and Gate Schedules.

C. Except where noted otherwise, valves designated for water service shall conform to pertinent sections of the latest revision of AWWA C500 Specifications.

1.02 SUBMITTALS

A. As required in Section 40 05 51 – Valves General, and Section 01 33 00 – Submittal Procedures.

B. The Contractor shall furnish to the Owner, through the Engineer, a Performance Affidavit, utilizing the format specified in Section 46 00 00 – Equipment General Provisions.

C. Performance tests shall be conducted in accordance with the latest revision of AWWA C500 and affidavits shall conform to the requirements of the Specifications.

PART 2 – PRODUCTS

2.01 GATE VALVES

A. METAL SEATED GATE VALVE (GV-MS)

1. Size: Less than 2 Inch (Bronze Body)

a. Valves less than 2 inches shall be of bronze body, threaded bonnet, Non-rising stem (NRS), packed gland, solid wedge disc and minimum 300 psi non-shock cold water pressure rating. Valves shall have screwed ends or as specified otherwise. Manufactured by Crane Company, Jenkins Bros. Corp., or equal.

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B. RESILIENT WEDGE GATE VALVE (GV-RW)

1. Size: 4-Inch to 12-Inch

a. Gate valves 4 inch through 12 inch, rated for 250 psig working pressure.

b. Non-rising stem (NRS) design, shall fully comply with the requirements of AWWA C515 for resilient-seated gate valves and shall be manufactured by Kennedy Valve, Clow, or equal.

c. Gate valve body, bonnet, and wedge shall be cast iron conforming to ASTM A126, Class B. All pressure retaining joints shall be sealed with O-ring seals. Flat gaskets shall not be acceptable.

d. Stems and stem nuts shall be bronze. Stems shall contain integral thrust collars. NRS valves shall contain two O-rings above the stem thrust collar and one O-ring below the stem thrust collar. All stem O-rings shall be replaceable with valve in the full open position and subjected to full pressure. NRS stems shall have two low-friction thrust washers located above and below the stem collar to reduce operating friction.

e. Wedge shall be totally encapsulated with a permanently bonded rubber material. Rubber shall be suitable for use in potable, non-potable, and reuse water and shall be EPDM.

f. Waterway shall be smooth, unobstructed, and free of all pockets, cavities, and depressions in the seat area.

g. Body, bonnet, and stuffing plate shall be shop coated inside and out with a fusion bonded epoxy (10 mils minimum dry film thickness) complying with AWWA C550 and shall be NSF-61 certified. Damage surfaces shall be repaired in accordance with the manufacturer’s recommendations.

h. Valves shall be flanged or mechanical joint as shown on the drawings. At tapping sleeves, valves shall utilize a tapping flange.

i. Provide 2-inch square standard AWWA operating nut unless otherwise shown on the Drawings or specified herein.

j. All valve assembly hardware shall be minimum 304 stainless steel.

2. Size: 14-Inch through 54-Inch

a. Gate valves 14 inch through 54 inch, rated for 250 psig working pressure.

b. Non-rising stem (NRS) design, shall fully comply with the requirements of AWWA C515 for resilient-seated gate valves and shall be manufactured by Kennedy Valve, Clow, or equal.

c. Gate valve body, bonnet, and wedge shall be ductile iron conforming to ASTM A536, Grade 65. All pressure retaining joints shall be sealed with O-ring seals. Flat gaskets shall not be acceptable.

d. Stems and stem nuts shall be bronze. Stems shall contain integral thrust collars. NRS valves shall contain two O-rings above the stem thrust collar and one O-ring below the stem thrust collar. All stem O-rings shall be replaceable with valve in the full open position and subjected to full pressure. NRS stems shall have two low-friction thrust washers located above and below the stem collar to reduce operating friction.

e. Wedge shall be totally encapsulated with a permanently bonded rubber material. Rubber shall be suitable for use in potable, non-potable, and reuse water and shall be EPDM.

f. Provide stainless steel tracks, bronze rollers, and bronze scrapers on valves 24-inch and larger.

g. Waterway shall be smooth, unobstructed, and free of all pockets, cavities, and depressions in the seat area.

h. Body, bonnet, and stuffing plate shall be shop coated inside and out with a fusion bonded epoxy (10 mils minimum dry film thickness) complying with AWWA C550 and shall be NSF-61 certified. Damage surfaces shall be repaired in accordance with the manufacturer's recommendations.

i. Valves 18-inch and larger shall be equipped with a gearbox. Extensions, gearbox housing, and adapter plates shall be ductile iron conforming to ASTM A536, Grade 65.

j. Valves shall be flanged or mechanical joint as shown on the drawings. At tapping sleeves, valves shall utilize a tapping flange.

k. Provide 2-inch square standard AWWA operating nut unless otherwise shown on the Drawings or specified herein.

l. All valve assembly hardware shall be minimum 304 stainless steel.

END OF SECTION

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SECTION 40 05 65.23
CHECK VALVES

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. Reference Section 40 05 00 – Basic Mechanical Requirements.

B. Valves intended for chemical service shall be constructed of materials suitable for the intended service.

PART 2 – PRODUCTS

2.01 FLANGE INSERT CHECK VALVES (CV-FI)

A. The Contractor shall provide flange insert check valves (FIVs) for installation in the vertical overflow lines of bulk storage and day tanks located inside. The valves shall be designed for insertion between two mating ANSI flanges, and valve size shall match tank overflow line size. Flanges and gaskets shall be provided by the Contractor. Valve bodies shall be constructed of PVC, valve seats shall be constructed of Viton, and metal springs shall be constructed of Alloy C-276 or FEP-encapsulated SS. Each valve shall have a cracking pressure of 1/2 psig. Flange insert check valves shall be as manufactured by Check-All Valve Manufacturing Company, or equal.

PART 3 – EXECUTION (NOT USED)

END OF SECTION

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SECTION 40 05 68.13
PVC AND CPVC VALVES

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. Reference Section 40 05 00 – Basic Mechanical Requirements.

PART 2 – PRODUCTS

2.01 MATERIALS OF CONSTRUCTION

A. Valves shall be constructed of materials suitable for the intended service. PVC valves shall be provided in PVC piping and CPVC valves shall be provided in CPVC piping.

B. PVC valve bodies shall be constructed of PVC which shall meet or exceed the requirements of cell classification 12454 according to ASTM D1784. CVPC valve bodies shall be constructed of CPVC which shall meet or exceed the requirements of cell classification 23447 according to ASTM D1784.

C. Materials of construction of other valve components shall be as specified below for the particular type of valve.

D. Acceptable materials of construction of elastomers for chemical service shall be as follows:

Chemical Service	Elastomer Material
Chlorine Solution (from gas)	FKM
Sodium Hypochlorite	FKM

E. Acceptable materials of construction of elastomers for non-chemical service shall be as follows:

Non-Chemical Service	Elastomer Material
Non-Potable Water	EPDM
Process Drain (Gravity)	EPDM, FKM
Potable Water	EPDM
Reclaimed Water	EPDM, FKM

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Non-Chemical Service	Elastomer Material
Sample	EPDM, FKM

F. All flanged valves shall be flat face flanged end type conforming to ANSI B16.5 bolt pattern for 150 lb. flanges.

2.02 PVC/CPVC BALL VALVES (BLV-P/BLV-C)

A. Ball valves shall be true union design with flanged, socket, or threaded ends as required and as specified in Section 40 06 20 – Process Pipe, Valve, and Gate Schedules. All valves shall be full-port design and allow for bi-directional flow. Valve stems shall contain double O-ring seals. Valves shall have removable handles and integrally molded mounting features for actuator installation. Ball valves shall be rated for a minimum pressure of 150 psi at 70°F.

B. Valve bodies, stems, balls, and unions shall be constructed of PVC or CPVC as specified in 2.01 B. Ball seats shall be made of PTFE, and O-ring seals shall be as specified in 2.01 D and 2.01 E.

C. Ball valves shall be manufactured by Asahi/America, Nibco/Chemtrol, IPEX, Hayward Flow Control, Plastomatic, or equal.

D. Ball valves for sodium hypochlorite service shall be vented, with a single hole factory-drilled into the ball to vent in the upstream direction when the ball is in the closed position. Valves shall be color coded or marked to indicate vented ball design.

E. Where valves are installed in piping to be insulated and jacketed, stem extensions shall be furnished and installed such that the valve can be operated without any interference with these components.

2.03 PVC/CPVC SWING CHECK VALVES (CV-PS/CV-CS)

A. Swing check valves shall be single-disc design with pivoting swing arm/disc clapper assembly and flanged ends. Valves shall be full flow, gravity operated, and suitable for either horizontal or vertical applications. Valves shall be capable of top entry to facilitate cleaning and repair without removal from the line. Swing check valves shall be pressure rated for 150 psi at 70°F.

B. Valve bodies, bonnets, swing arms, and discs shall be constructed of PVC or CPVC as specified in 2.01 B. O-ring seals and shutters shall be as specified in 2.01 D and 2.01 E.

C. Swing check valves shall be manufactured by Asahi/America, IPEX, Hayward Flow Control, or equal.

2.04 PVC/CPVC BALL AND DIAPHRAGM CHECK VALVES (DCV-P/DCV-C)

A. Ball and diaphragm check valves shall be true union design with flanged, socket, or threaded ends as required and as specified in Section 40 06 20 – Process Pipe, Valve, and Gate Schedules. Primary seat shall be square-cut design to ensure proper seating. Valves shall be suitable for either horizontal or vertical applications. Ball and diaphragm check valves shall be pressure rated for 150 psi at 70°F.

B. Valve bodies, balls or diaphragms, end connectors, and unions shall be constructed of PVC or CPVC as specified in 2.01 B. O-ring seals shall be as specified in 2.01 D and 2.01 E.

C. Ball and diaphragm check valves shall be manufactured by Asahi/America, Nibco/Chemtrol, IPEX, Hayward Flow Control, Plastomatic, or equal.

2.05 PVC/CPVC DIAPHRAGM VALVES (DV-P/DV-C)

A. Diaphragm valves shall be weir-type design with multi-turn handwheel for throttling applications. Diaphragm valves shall have flanged, socket, or threaded ends as specified in Section 40 06 20 – Process Pipe, Valve, and Gate Schedules. Valves shall have a position indicator and adjustable travel stop. Diaphragm valves shall be pressure rated for 150 psi at 70°F.

B. Valve bodies, bonnets, end connectors, and unions shall be constructed of PVC or CPVC as specified in 2.01 B. Valve diaphragms and O-rings shall be as specified in 2.01 D and 2.01 E. PVDF vapor barrier shall be provided for PTFE diaphragms.

C. Diaphragm valves shall be manufactured by Asahi/America, IPEX, Hayward Flow Control, Plastomatic, or equal.

2.06 PVC/CPVC BUTTERFLY VALVES (BFV-P/BFV-CP)

A. Butterfly valves shall be of flanged design. Valves 6” and smaller shall have lever handles, and larger valve shall have gear operators. Valves shall have the ability to mount actuators. Face seals shall completely isolate the valve body from process flow and function as a flange gasket on both sides of the valve. Butterfly valves shall be pressure rated for 150 psi at 70°F. Butterfly valves shall be lugged type.

B. Valve bodies and discs shall be constructed of PVC or CPVC as specified in 2.01 B. Valve shafts shall be made of 316 stainless steel, Titanium, or Hastelloy C. Valve disc liners and O-ring seals shall be as specified in 2.01 D and 2.01 E.

C. Butterfly valves shall be as manufactured by Asahi/America Type 57 IL, Nibco/Chemtrol, IPEX, Hayward Flow Control, Plastomatic, or equal.

2.07 PVC/CPVC DEGASSING VALVES (DGS-P/DGS-C)

A. Degassing valves shall be provided to continuously vent gases for a liquid-carrying pipeline or vessel. The float-operated valve will open when liquid level falls (indicating the presence of gas) and close when the gas has been evacuated as the liquid level rises. The valve is to automatically vent gas collected over liquid to a pressure of 100 PSI. The specific gravity of the liquid shall not be less than 0.9. Degassing valves shall be installed vertically, at high points in the piping system where gases collect.

B. The Valve body shall be PVC or CPVC. The internal float shall be constructed of Natural Polypropylene. Seals shall be EPDM or Viton, as specified above. There shall be a ½" Female NPT process connection and 1/8" Female NPT vent port.

C. Degassing Valves shall be as manufactured by Plastomatic, or equal.

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 40 05 68.23
MISCELLANEOUS VALVES

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. Reference Section 40 05 00 – Basic Mechanical Requirements.

B. Valves intended for chemical service shall be constructed of materials suitable for the intended service.

PART 2 – PRODUCTS

2.01 BACKFLOW PREVENTION VALVES

A. Reduced Pressure Style (BFPV-RP)

1. Reduced Pressure Backflow Preventer shall be of the size shown on the Drawings and shall be of the reduced pressure principle type in accordance with AWWA Standards C510 and C511, with two (2) independent operating spring-loaded check valves and one (1) spring loaded, diaphragm actuated, differential pressure relief valve shall be installed between the check valves. Backflow preventer shall be bronze body construction, with EPT rubber discs and Buna-N and nylon diaphragm. Screws and springs shall be of stainless steel. End connections shall be screwed, unless otherwise specified or shown on the Drawings. Reduced pressure backflow preventer installations shall include isolation valves and four test cocks, furnished as an assembly. For reduced pressure backflow preventers less than 2-1/2" the installation assembly also shall include a strainer. Isolation valves for reduced pressure backflow preventers shall be ball valves, except for sizes 2-1/2" and larger which shall be resilient seat gate valves. Test cocks shall be located as recommended by the manufacturer to facilitate functional testing of the assembly. The reduced pressure backflow preventer shall be as manufactured by Beeco Division, Hersey Products Inc., Aergap Model 6CM, WATTS 909, or equal.

2.02 PRESSURE RELIEF, REDUCING AND REGULATING VALVES

A. Pressure Relief Valve (PRV)

1. **Smaller than 3-Inch**. Pressure relief valves 1 inch and under shall have bronze bodies and above 1 inch shall have cast iron bodies, bronze fitted with grey iron diaphragm base and straight chamber and phosphorus bronze diaphragm. The ratio of the diaphragm area to the seat area shall be adequate to overcome sticking. The seat disc shall be of non-corrodible, non-sticking material capable of

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withstanding extreme temperatures. Valves shall permit dismantling for repairs and cleaning without being removed from the line. Valves shall conform to the ASME Boiler Construction Code as approved by both the Underwriters Lab., and the National Board of Boiler Pressure Vessel Inspectors. All valves shall be designed for a minimum working pressure at least equal to the working pressure of the corresponding pipeline and shall have adjustment over a range of at least 20 percent above or below the required setting pressure of the installation.

2. **3-Inch and Larger**. Pressure relief valves (non-potable water service) shall be diaphragm activated, single seat, pilot operated and shall maintain a constant upstream pressure by relieving excess pressure. The valve shall be normally closed and shall open to maintain the required back pressure when the valve inlet pressure reaches the pilot control set point. The initial pilot control setting shall be 78 psi. The stem shall be stainless steel and shall be guided through the center for 100% of the stem travel. The main valve throttling plug shall be provided with V-port sections to insure precise control at low flow rates. All internal metal parts shall be bronze or stainless steel. The control pilot shall be direct acting, spring loaded, and adjustable with bronze body and stainless steel trim. The diaphragm and seat disc shall be BUNA-N. The valve shall be of the angle or globe pattern as shown on the Drawings and shall be fully repairable in the line. The pressure relief valve shall be the Model 50-01 as manufactured by CLA-VAL, or equal.

    a. **Non-Potable or Reuse Water Use**. Where pressure relief valves are expected to come in contact with Non-Potable or Reuse Water, the pilot piping and control pilot shall be stainless steel.

B. Pressure Reducing and Regulating Valve (PRGV)

1. **Smaller than 3-inch**. Pressure reducing and regulating valves 1/2-inch and under shall be bronze and above 1/2-inch but less than 3-inch size shall have cast iron bodies bronze fitted. Valves shall be constructed with full openings and capable of supplying a full flow of water at reduced pressure. Valves shall be so constructed that repairs can be made without removing the valves from the line. The valves shall be equipped with a sedimentation chamber and stainless steel or bronze strainer. Pressure reducing and regulating valves shall be the back pressure sustaining type and shall operate over a range at differential pressures from 5 to 120 psi. Reducing and regulating valves shall meet or exceed the requirements of ASSE 1003 (ANSI A112.26.2) and shall be WATTS model LF25AUB-Z3, Zurn Wilkins model 600XLHTSTSC, or equal.

2. **3-Inch and Larger**. Pressure reducing and regulating valves 3-inch size and larger shall be diaphragm activated, single seat, pilot operated and shall automatically reduce a higher inlet pressure to a steady lower downstream pressure, regardless of changing flow rate and/or varying inlet pressure. This valve is an accurate, pilot-operated regulator capable of holding downstream pressure to a pre-determined limit. When downstream pressure exceeds the pressure setting of the control pilot,

the main valve and pilot valve close drip-tight. The initial pilot control setting shall be 60 psi. The stem shall be stainless steel and shall be guided through the center for 100% of the stem travel. The main valve throttling plug shall be provided with V-port sections to insure precise control at low flow rates. All internal metal parts shall be bronze or stainless steel. The control pilot shall be direct acting, spring loaded, and adjustable with bronze body and stainless steel trim. The diaphragm and seat disc shall be BUNA-N. The valve shall be of the angle or globe pattern as shown on the Drawings and shall be fully repairable in the line. The pressure relief valve shall be the Model 90-01 as manufactured by CLA-VAL, or equal.

a. **Non-Potable or Reuse Water Use**. Where pressure reducing and regulating valves are expected to come in contact with Non-Potable or Reuse Water, the pilot piping and control pilot shall be stainless steel.

2.03 HOSE VALVES (HV)

A. Hose valves shall be 300 lbs. non-shock cold water angle or globe valves, Fig. 112/113 as manufactured by Jenkins Valve Co., or equal. Valves shall be bronze bodied with Buna-N or neoprene disc and bronze bonnet and packing nut. Valve stem, gland, and lock nut shall be brass. Valve shall be provided with 3-inch diameter malleable iron handwheel, cap and chain, and 3/4-inch or 1-inch (or 2-inch near flushing connections) hose connection outlet.

END OF SECTION

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SECTION 40 05 78

AIR VALVES FOR WATER AND WASTEWATER SERVICE

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. Reference Section 40 05 00 – Basic Mechanical Requirements.

B. The Contractor shall furnish and install, complete with all assemblies and accessories, all air valves shown on the Drawings and specified herein including all fittings, appurtenances, drain connections, and transition pieces required for a complete and operable installation.

C. All valves shall be constructed of materials which have strength, wearing, and corrosion resistance characteristics entirely suitable for chlorine solution water. Valves shall conform to pertinent sections of the latest edition of their respective governing AWWA standards, except as may be modified to comply with pressure ratings specified herein.

D. Valves intended for chemical service shall be constructed of materials suitable for the intended use.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Except as otherwise indicated, the current editions of the following standards apply to the work of this section:

1.	ANSI/AWWA C512	Air Release, Air/Vacuum, and Combination Air Valves for Water and Wastewater Service
2.	NSF-61, NSF-372, and NSF-600	All products in contact with potable water shall be certified

B. Reference Section 46 00 00 – Equipment General Provisions for additional requirements.

1.03 CONTRACTOR SUBMITTALS

A. The following shall be submitted in compliance with Section 01 33 00 – Submittal Procedures:

1. Submit an Affidavit of Compliance for each valve type indicating the valve complies with the latest edition of its governing AWWA Standard.

2. Submit all catalog data information, installation drawings, specifications, layout dimensions, size and materials of construction for all components, pressure

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ratings, support and anchoring, complete descriptive literature to demonstrate full compliance, and manufacturer's certification that products comply with the indicated requirements.

3. Submit operation and maintenance (O&M) manuals and installation instructions for all valves. O&M manuals shall not include information and/or details which do not apply to the equipment being furnished. O&M manuals shall include:

   a. Manufacturer's catalog data.

   b. Manufacturer's installation and operations instructions.

   c. Manufacturer's maintenance procedures.

   d. List of special tools.

PART 2 – PRODUCTS

2.01 GENERAL

A. All valve body castings shall be clean, sound, and without defects of any kind. No plugging, welding, or repairing of defects will be allowed.

B. Air valves shall be provided with appropriate materials to provide drip tight closure.

C. Valves 2-inch and smaller shall have NPT threaded inlets and outlets.

D. Valves shall permit dismantling for repairs and cleaning without being removed from the line. All air valves shall include a ball valve of the same diameter as the nominal valve size located on the inlet side for isolation, unless otherwise detailed or noted on the drawings.

E. Unless otherwise directed by the Owner, isolation valves shall open counterclockwise.

F. The exhaust from the valve shall be piped to a suitable disposal point, with the piping firmly supported and installed in such a way as to avoid splashing and wetting of floors. Exhaust piping shall be no smaller than the diameter of the air valve's largest orifice.

G. For valves where insect screens are required, confirm that the open surface area between the insect screen mesh is no less than the area of the largest air valve orifice so as not to restrict air flow.

H. All internal and external ferrous components and surfaces of the valves, with the exception of stainless steel and finished or bearing surfaces, shall be shop painted with two coats (10 mils min. dry film thickness) of the manufacturer's premium epoxy for corrosion resistance. Damaged surfaces shall be repaired in accordance with the manufacturer's recommendations.

I. One spare valve shall be provided for each size and type of valve specified.

2.02 AIR VALVES FOR POTABLE AND NON-POTABLE WATER SERVICE

A. The valves specified in this section shall be specifically designed for water service.

B. All air valves for water service 1-inch in diameter and larger shall have a ¼-inch minimum diameter drain plug.

C. Air Release Valves (ARV): ARVs for water service shall be designed to operate (open) while pressurized allowing entrained air in a water pipeline to escape through the air release orifice. After entrained air escapes through the air release orifice, the valve orifice shall close tightly. The air release orifice will then remain closed until more air accumulates and the opening cycle repeats automatically.

D. Air/Vacuum Valves (AVV): AVVs for water service shall automatically allow large volumes of air to be released through a large orifice during pipe filling and automatically allow large volumes of air to enter through a large orifice during pipe draining. AVVs shall be designed to react immediately to open when the absolute pressure in the pipeline falls below atmospheric pressure by opening a large orifice.

E. Combination Air Release and Air/Vacuum Valves (CARV): CARVs for water service shall provide the same function as both ARVs and AVVs listed above. CARVs may be a single body housing specifically designed for use with water mains.

F. Sealing pressure is listed in the Valve Parameters Table below.

G. Acceptable manufacturers: A.R.I., Vent-tech International, Vent-O-Mat, Cla-Val, or equal.

1. Materials of Construction

Component	Material
Cover, Body, Extension Assy.	316 Stainless Steel
Clamping Stem	Reinforced Nylon / Polypropylene
Float	Ultra-High Molecular Weight Polyethylene (UHMW), Polypropylene, Stainless Steel, or High Density Polyethylene (HDPE)
Rolling Seal, Seat	Viton or EPDM
Trim	316 Stainless Steel
O-rings	Viton or EPDM
Connection – 2” or smaller	NPT Threaded

H. Valve parameters:

Line Designation and Location	Qty	Model	Size	Normal Operating Pressures (psig)[1]	Air Release Valve Venting Rate (scfm)	Discharge Capacity @ ∆2 psi (scfm)	Intake Capacity @ ∆-5 psi (scfm)	Notes
3" CLS	2	CARV	1"	3-30	0.25	5	-10	Up to 200mg/l Cl_2 solution
4" CLS	1	CARV	1"	2-20	0.7	10	-20	Up to 650mg/l Cl_2 solution

NOTES: 1) The listed minimum operating pressure is the sealing pressure required to prevent air valve leakage.

PART 3 – EXECUTION

3.01 TESTING

A. Testing shall be performed in accordance with the latest revision of AWWA C512.

B. Minimum test pressure - air valves for water and wastewater service shall be tested at 20 psig or the minimum operating pressure, whichever is lower.

C. Maximum test pressure - air valves for water and wastewater service shall be tested at 150% of the maximum design pressure.

D. Before installation, all valves shall be lubricated, manually opened and closed to check their operation and the interior of the valves shall be thoroughly cleaned.

3.02 SHIPMENT

A. Valves shall be complete in all details when shipped. Cavities shall be drained of water to protect from freezing. The openings shall be covered to prevent entry of foreign material, and the threads shall be protected. The manufacturer shall carefully prepare the valves for shipment. Valves shall be fully packaged or attached to pallets at the manufacturer's option.

3.03 INSTALLATION

A. Install all air valves in accordance with the manufacturer's recommendations.

END OF SECTION

SECTION 40 05 97
PIPING AND EQUIPMENT IDENTIFICATION SYSTEMS

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish and install all components of the system for identification of piping and equipment as specified hereinafter. The system shall include the application of color coding to all new and altered plant piping. The Contractor shall paint the equipment and piping of all Contracts in the colors herein specified, and in accordance with the requirements of Section 09 90 00 – Painting.

B. In addition to the legends specified herein, the Engineer may order the Contractor to furnish and install additional identification legends and arrows at no additional cost to the Owner. Such additional signs may be requested near completion of the work and shall be limited to no more than five (5) signs for each type specified herein. The legends and color combinations for additional signs shall conform to the requirements specified herein.

C. The Contractor shall submit a schedule of the colors and designations proposed in accordance with Section 01 33 00 – Submittal Procedures and this Section. A minimum of four (4) color charts with cross-references to the colors listed herein shall be included with the Submittal.

D. Reference Section 40 05 00 – Basic Mechanical Requirements.

PART 2 – PRODUCTS

2.01 PIPING BAND

A. All new and altered piping shall receive identification bands. Such bands shall be 6-inches wide, neatly made by masking, and spaced at intervals of 30-inches on centers regardless of the diameter of the pipe being painted. The Contractor may use approved precut and prefinished metal bands on piping, in lieu of the masked and painted bands, where approved by the Engineer.

2.02 PIPING IDENTIFICATION LEGEND

A. The Contractor shall apply identification legends to all types and sections of piping as shown on the Drawings or as designated by the Engineer. Such legends shall be in the form of plain block lettering giving the name of the pipe content in full or abbreviated form and showing the direction of flow by arrows. All lettering and arrows shall be of the plastic snap-on type, Seton nameplate "setmarks", or equal, or they shall be formed by stenciling in an approved manner using white or black as directed and shall have an

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overall height in inches in accordance with the following table:

Diameter of Pipe or Pipe Covering	Height of Lettering
3/4 to 1-1/4 inches	1/2-inches
1-1/2 to 2-inches	3/4-inches
2-1/2 to 6-inches	1-1/4-inches
8 to 10-inches	2-1/2-inches
Over 10-inches	3-1/2-inches

B. Identification lettering shall be located midway between color coding bands where possible. Identification lettering and arrows shall be placed as directed by the Engineer, but shall generally be located each fifteen (15) feet in pipe length, and shall be properly inclined to the pipe axis to facilitate easy reading. In the event lettering and arrow identifications are required for piping less than 3/4-inch in diameter, the Contractor shall furnish and attach approved color-coded tags where instructed.

C. The colors referenced in the legend are as manufactured by KOP-COAT. They are used for convenience only.

D. Piping and Equipment Identification

Service	Legend	Base
Chlorine Solution	Chlorine Solution	Medium Yellow
Non-Potable Water	Non-Potable Water	Safety Purple
Potable Water	Potable Water	Safety Blue
Reuse Water	Reuse Water	Safety Purple
Sanitary and Process Drains	Drain	Black
Sodium Hypochlorite	Sodium Hypochlorite	Safety Yellow

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 40 06 20
PROCESS PIPE, VALVE, AND GATE SCHEDULES

PART 1 - GENERAL

1.01 THE REQUIREMENT

A. Reference Section 40 05 00 - Basic Mechanical Requirements.

1.02 PIPING SCHEDULES

A. Piping requirements for this Section are outlined on the Drawings and in the Piping Schedules. In the absence of a specified test pressure, pipe shall be tested at the greater of: 1) 150 percent of working pressure as determined by the Engineer or 2) 10 psig, unless the Schedule indicates no test is required.

B. If the pipe material is not shown on the Piping Schedule or otherwise specified, the following materials shall be used.

PIPE SIZE	MATERIAL	TYPE OF JOINT	CLASS/DESIGN	TEST PRESSURE
4-IN AND LARGER	DIP	FLANGED (EXPOSED)	CLASS 53	(1)
		RESTRAINED (BURIED)	PRESSURE CLASS 350	
LESS THAN 4-IN	PVC/CPVC (2)	SOCKET	SCH 80	(1)

(1) Test at 150 percent of working pressure or 10 psi, whichever is greater.
(2) For all PVC / CPVC designations, for this project CPVC shall be used unless PVC is specifically called out on the Drawings.

1.03 VALVE SCHEDULES

A. All valves shall be tagged by the manufacturer according to the control valve designations listed in this Section.

B. Valves not listed in this Section shall be manually operated, unless otherwise shown on the Drawings.

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WASTEWATER TREATMENT PLANT PIPING SCHEDULE

PIPE DESIGNATIONS		MATERIAL	BURIED PIPING		EXPOSED PIPING			DESIGN PRESSURE (PSI)[1]			
			TYPE OF JOINT	CLASS/ DESIGN	TYPE OF JOINT	CLASS/ DESIGN	HEAT TRACE[2]	WORKING	SURGE	RESTRAINT	FIELD TEST
NPW	NON-POTABLE (SERVICE) WATER	< 4" PVC / CPVC[3]	SOCKET	SCH 80	SOCKET/ FLANGED	SCH 80	NO	100	125	150	150
		>=4" PVC (replace in kind)	DI MJ RESTRAINED	C900 PC235 DR18	NOT APPLICABLE	NOT APPLICABLE	NO				
		> = 4" DIP (replace in kind)	RESTRAINED	PRESSURE CLASS 350	FLANGED	CLASS 53	NO				
PDG	PROCESS DRAIN GRAVITY	< 4" PVC / CPVC[3]	SOCKET	SCH 80	SOCKET/ FLANGED	SCH 80	NO	GRAVITY	NA	NA	5[5]
		> = 4" DIP	RESTRAINED	PRESSURE CLASS 350	FLANGED	CLASS 53	NO				
PW	POTABLE WATER	< 4" PVC / CPVC[3]	SOCKET	SCH 80	SOCKET/ FLANGED	SCH 80	NO	100	125	150	150
		>=4" PVC (replace in kind)	DI MJ RESTRAINED	C900 PC235 DR18	NOT APPLICABLE	NOT APPLICABLE	NO				
		> = 4" DIP (replace in kind)	DI MJ RESTRAINED	PRESSURE CLASS 350	FLANGED	CLASS 53	NO				
SPD	SUMP PUMP DISCHARGE	< 4" PVC / CPVC[3]	SOCKET	SCH 80	SOCKET/ FLANGED	SCH 80	NO	30	40	50	50

1) Surge pressure is the maximum pressure in the system during a surge event. Restraint pressure shall be used to determine pipe joint design and if required, the size, number, material, and dimensions of tabs and threaded-rods and thrust blocking for thrust restraint of piping and piping system components specified.
2) Provide heat tracing and insulation as specified in Section 40 41 13 on all exposed outdoor piping indicated.
3) For all PVC / CPVC designations, for this project CPVC shall be used unless PVC is specifically called out on the Drawings.
4) Flanges shall be provided as shown on the drawings or as approved by the Engineer.
5) Gravity pipe pressure test to utilize air at not greater than 5 psi.

CHEMICAL PIPING SCHEDULE

PIPE DESIGNATIONS		MATERIAL	BURIED PIPING		EXPOSED PIPING			DESIGN PRESSURE (PSI)[1]		
			TYPE OF JOINT	CLASS/ DESIGN	TYPE OF JOINT	CLASS/ DESIGN	HEAT TRACE[2]	WORKING	RESTRAINT	FIELD TEST
CLS	CHLORINE SOLUTION	< 4" PVC / CPVC[3]	SOCKET	SCH 80	SOCKET/ FLANGED	SCH 80	NO	100	150	150
		PVC HOSE (IN CCP)	COMPRESSION	SECTION 40 05 31	N/A	N/A	NO			
CCP	CHEMICAL CASING PIPE	< 4" PVC / CPVC[3]	SOCKET	SCH 40 (LONG RADIUS BENDS)	SOCKET/ FLANGED	SCH 40 (LONG RADIUS BENDS)	NO	N/A	N/A	10
SH	SODIUM HYPHOCHLORITE	< 4" PVC / CPVC[3]	SOCKET	SCH 80	SOCKET/ FLANGED	SCH 80	NO	100	120	150
		HDPE	FUSION	SDR 11	N/A	N/A	NO			
		PVC HOSE (IN CCP)	COMPRESSION	SECTION 40 05 31	N/A	N/A	NO			

1) Surge pressure is the maximum pressure in the system during a surge event. Restraint pressure shall be used to determine pipe joint design and if required, the size, number, material, and dimensions of tabs and threaded-rods and thrust blocking for thrust restraint of piping and piping system components specified.
2) Provide heat tracing and insulation as specified in Section 40 41 13 on all exposed outdoor piping indicated.
3) For all PVC / CPVC designations, for this project CPVC shall be used unless PVC is specifically called out on the Drawings.
4) Flanges shall be provided as shown on the drawings or as approved by the Engineer.

END OF SECTION

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SECTION 40 61 13
PROCESS CONTROL SYSTEM GENERAL PROVISIONS

PART 1 – GENERAL

1.01 SCOPE

A. The Contractor shall provide, through the services of an instrumentation and control system subcontractor, components, system installation services, as well as required and specified ancillary services in connection with the Instrumentation, Control and Information System.

B. The System includes materials, labor, tools, fees, charges, and documentation required to furnish, install, test and place in operation a complete and operable instrumentation, control and information system.

C. The system shall include measuring elements, signal converters, transmitters, local control panels, digital hardware and software, operator workstations, remote telemetry units, signal and data transmission systems, interconnecting wiring, and pertinent accessories.

D. The scope of the work to be performed under this Division includes but is not limited to the following:

1. The Contractor shall retain overall responsibility for the instrumentation and control system as specified herein.

2. Furnish and install process instrumentation and associated taps and supports as scheduled or shown on the Drawings, unless otherwise noted or supplied by equipment vendors.

3. Furnish and install local control panels, field panels and associated cabinets and panels as shown on the Drawings and as specified in Sections 40 61 13 through 40 79 00, inclusive and where included.

4. Furnish and install digital control system hardware and software as specified in this Division.

    a. Local Control Panels (LCPs).

    b. Remote I/O (RIO) system and appurtenances.

    c. Ethernet switches, cables and appurtenances.

5. Furnish, install and terminate special cables for devices (e.g., instruments, printers, radios). Furnish and terminate control system communication network cables.

6. Furnish and install a new Sodium Hypochlorite Temporary System, including the provision and integration of the Sodium Hypochlorite Temporary System Control Panel (PLC-4 RIO RACK 5) equipped with RIO-5. The RIO-5 Rack shall be fully integrated with the existing PLC-4 as shown on the I-02 Network Block Diagram. Contractor shall be responsible for the termination of all fiber optic cables, patch panels, and any other necessary components to ensure the proper operation of the control panel. All work shall be performed in accordance with the project specifications and city standards to guarantee seamless functionality and integration with existing systems.

7. Contractor shall modify the existing PLC-4 (M850) programming logic, as required to include the functionalities described on specification Section 40 61 96 – Process Control Descriptions and as shown on the Instrumentation drawings.

8. Contractor shall modify the existing WWTP SCADA HMI graphic displays and develop new SCADA HMI graphics displays, as required to include the new processes and I/O signals, as shown on the Instrumentation drawings and as described in this Division.

9. Contractor shall, at a minimum, configure the SCADA historian software to trend all metering pump “Calculated Flow Capacity” values, storage tank level values and all alarms and setpoints associated with the chemical storage and feed system.

10. Contractor shall be responsible for handing over to the Owner a complete, working chemical metering control system that meets the requirements specified in this Division with no degradation or loss of control and monitoring capability from that of the original system.

11. Final termination and testing of instrumentation and control system signal wiring and power supply wiring at equipment furnished under Sections 40 61 13 through 40 79 00, inclusive and where included.

12. Furnish and install transient voltage surge suppression systems for all digital equipment, control panels, and field instruments provided by the instrumentation and control system subcontractor, including connections to grounding system(s) provided under Division 26. Coordinate grounding requirements with the Electrical Contractor for all digital equipment, local control panels, and instrumentation provided under this Division.

13. Coordinate grounding requirements with the electrical subcontractor for digital equipment, local control panels, and instrumentation provided under this Division. Terminate grounding system cables at equipment provided under this Division.

14. Provide system testing, calibration, training and startup services as specified herein and as required to make systems fully operational.

E. It is the intent of the Contract Documents to construct a complete and working installation. Items of equipment or materials that may reasonably be assumed as necessary to accomplish this end shall be supplied whether or not they are specifically stated herein.

1.02 RELATED ITEMS

A. Field mounted switches, torque switches, limit switches, gauges, valve and gate operator position transmitters, sump pump controls, and other instrumentation and controls furnished with mechanical or electrical equipment not listed in the instrument schedule shall be furnished, installed, tested, and calibrated as specified under other Divisions unless otherwise indicated.

B. Additional and related work performed under Division 26 includes the following:

1. Instrument A.C. power source and disconnect switch for process instrumentation, A.C. grounding systems, and A.C. power supplies for equipment, control panels and accessories furnished under Sections 40 61 13 through 40 79 00, inclusive and where included.

2. Conduit and raceways for instrumentation and control system signal wiring, grounding systems, special cables and communication network cables.

3. Instrumentation and control system signal wiring.

4. Install control system communication network cables.

5. Furnish and install grounding systems for digital equipment, local control panels, and instrumentation provided under Sections 40 61 13 through 40 79 00, inclusive and where included. Grounding systems shall be complete to the equipment provided under Sections 40 61 13 through 40 79 00, inclusive, and where included, ready for termination by the instrumentation subcontractor.

6. Termination of instrumentation and control system signal wiring at equipment furnished under other Divisions of the Specifications.

7. Final wiring and termination to A.C. grounding systems and to A.C. power sources (e.g., panelboards, motor control centers, and other sources of electrical power).

1.03 GENERAL INFORMATION AND DESCRIPTION

A. Where manufacturers are named for a particular item of equipment, it is intended as a guide to acceptable quality and performance and does not exempt such equipment from the requirements of these Specifications or Drawings.

B. In order to centralize responsibility, it is required that equipment (including field instrumentation and control system hardware and software) offered under this Division shall be furnished and installed by the instrumentation subcontractor, or under the supervision of the instrumentation subcontractor, who shall assume complete responsibility for proper operation of the instrumentation and control system equipment, including that of coordinating signals, and furnishing appurtenant equipment.

C. The Contractor shall retain total responsibility for the proper detailed design, fabrication, inspection, test, delivery, assembly, installation, activation, checkout, adjustment and operation of the entire instrumentation and control system as well as equipment and controls furnished under other Divisions of the Specifications. The Contractor shall be responsible for the delivery of detailed drawings, manuals and other documentation required for the complete coordination, installation, activation and operation of mechanical equipment, equipment control panels, local control panels, field instrumentation, control systems and related equipment/systems and shall provide for the services of a qualified installation engineer to supervise activities required to place the completed facility in stable operation under full digital control.

D. The instrumentation and control system shall be capable of simultaneously implementing all real time control and information system functions, and servicing all operator service requests as specified, without degrading the data handling and processing capability of other system components.

E. Control system inputs and outputs are listed in Section 40 61 93 – Process Control System Input/Output List. This information, together with the functional control descriptions, process and instrumentation diagrams, and electrical control schematics, describes the real time monitoring and control functions to be performed. In addition, the system shall provide various human/machine interface and data reporting functions as specified in the software sections of this Specification.

F. The mechanical, process, and electrical drawings indicate the approximate locations of field instruments, control panels, systems and equipment as well as field mounted equipment provided by others. The instrumentation subcontractor shall examine the mechanical, process and electrical drawings to determine actual size and locations of process connections and wiring requirements for instrumentation and controls furnished under this Contract. The instrumentation subcontractor shall inspect equipment, panels, instrumentation, controls, and appurtenances, either existing or furnished on the Project to determine requirements for interfacing with the control and information system. The Contractor shall coordinate the completion of required modifications with the associated supplier of the item furnished.

G. The instrumentation subcontractor shall review and approve the size and routing of instrumentation and control cable and conduit systems furnished by the electrical subcontractor for suitability for use with the associated cable system.

H. The Contractor shall coordinate the efforts of each supplier to aid in interfacing systems. This effort shall include, but shall not be limited to, the distribution of approved shop drawings to the electrical subcontractor and to the instrumentation subcontractor furnishing the equipment under this Division.

I. The Contractor shall be responsible for providing a signal transmission system free from electrical interference that would be detrimental to the proper functioning of the instrumentation and control system equipment.

J. The Owner shall have the right of access to the subcontractor's facility and the facilities of his equipment suppliers to observe materials and parts; witness inspections, tests and work in progress; and examine applicable design documents, records, and certifications during all stages of design, fabrication, and tests. The instrumentation subcontractor and his equipment suppliers shall furnish office space, supplies, and services required for these observation activities.

K. The terms "Instrumentation," "Instrumentation and Control System," and "Instrumentation, Control and Information System" shall hereinafter be defined as equipment, labor, services, and documents necessary to meet the intent of the Specifications.

1.04 INSTRUMENTATION AND CONTROL SYSTEM SUBCONTRACTORS

A. Instrumentation and control system subcontractors shall be regularly engaged in the detailed design, fabrication, installation, and startup of instrumentation and control systems for water treatment facilities, and remote telemetry systems for water supply/distribution systems. Instrumentation and control system subcontractors shall have a minimum of five years of such experience and shall have completed a minimum of three projects of similar type and size as that specified herein. Where specific manufacturers/models of major hardware or software products (PLC, HMI software, network, etc.) are specified to be used on this project, the instrumentation and control system subcontractor shall have completed at least one project using that specified hardware or software. As used herein, the term “completed” shall mean that a project has been brought to final completion and final payment has been made.

B. Acceptable instrumentation and control system subcontractors include:

1. C.C. Control Corporation, West Palm Beach, FL
   5760 Corporate Way West Palm Beach, FL 33407
   561-293-3975

2. Commerce Controls, Tampa, FL
   41069 Vincenti Court, Novi, MI
   248-476-1442

3. SJE (Revere Control Systems), Lakeland, FL
   4245 S. Pipkin Road Lakeland, FL 33811
   863-646-5781

1.05 DEFINITIONS

A. Solid State: Wherever the term solid state is used to describe circuitry or components in the Specifications, it is intended that the circuitry or components shall be of the type that convey electrons by means of solid materials such as crystals or that work on magnetic principles such as ferrite cores. Vacuum tubes, gas tubes, slide wires, mechanical relays, stepping motors or other devices will not be considered as satisfying the requirements for solid state components of circuitry.

B. Bit or Data Bit: Whenever the terms bit or data bit are used in the Specification, it is intended that one bit shall be equivalent to one binary digit of information. In specifying data transmission rate, the bit rate or data bit rate shall be the number of binary digits transmitted per second and shall not necessarily be equal to either the maximum pulse rate or average pulse rate.

C. Integrated Circuit: Integrated circuit shall mean the physical realization of a number of circuit elements inseparably associated on or within a continuous body to perform the function of a circuit.

D. Mean Time Between Failures (MTBF): The MTBF shall be calculated by taking the number of system operating hours logged during an arbitrary period of not less than six months and dividing by the number of failures experienced during this period plus one.

E. Mean Time to Repair (MTTR): The MTTR shall be calculated by taking the total system down time for repair over an arbitrary period of not less than six months coinciding with that used for calculation of MTBF and dividing by the number of failures causing down time during the period.

F. Availability: The availability of a non-redundant device or system shall be related to its MTBF and MTTR by the following formula:

   A = 100 x (MTBF / (MTBF + MTTR)) Percent

   The availability of a device or system provided with an automatically switched backup device or system shall be determined by the following formula:

   A = A2 + 1 - ((1 - A1) * (1 - A1))

   where:

      A1 = availability of non-redundant device or system

A2 = availability of device or system provided with an automatically switched backup device or system

G. Abbreviations: Specification abbreviations include the following:

1. A - Availability
2. ADC - Analog to Digital Converter
3. AI - Analog Input
4. AO - Analog Output
5. AVAIL - Available
6. BCD - Binary Coded Decimal
7. CSMA/CD - Carrier Sense Multiple Access/Collision Detect
8. CPU - Central Processing Unit
9. CRC - Cyclic Redundancy Check
10. CS - Control Strategy
11. DAC - Digital to Analog Converter
12. DBMS - Data Base Management System
13. DI - Discrete Input
14. DMA - Direct Memory Access
15. DO - Discrete Output
16. DPDT - Double Pole, Double Throw
17. DVE - Digital to Video Electronics
18. EPROM - Erasable, Programmable Read Only Memory
19. FDM - Frequency Division Multiplexing
20. FSK - Frequency Shift Keyed
21. HMI - Human Machine Interface (Software)
22. I/O - Input/Output

23. LAN - Network and Communication Equipment
24. LCD - Liquid Crystal Display
25. LDFW - Lead Follow
26. MCC - Motor Control Center
27. MTBF - Mean Time Between Failures
28. MTTR - Mean Time to Repair
29. OS - Operating System
30. PAC - Programmable Automation Controller
31. PCB - Printed Circuit Board
32. PID - Proportional Integral and Derivative Control
33. PLC - Programmable Logic Controller or Programmable Controller
34. PROM - Programmable Read Only Memory
35. RAM - Random Access Memory
36. RDY - Ready
37. RMSS - Root Mean Square Summation
38. RNG - Running
39. ROM - Read Only Memory
40. RTU - Remote Telemetry Unit
41. SPDT - Single Pole, Double Throw
42. ST/SP - Start/Stop
43. TDM - Time Division Multiplexing
44. UPS - Uninterruptible Power Supply
45. VFD - Variable Frequency Drive

H. To minimize the number of characters in words used in textual descriptions on displays, printouts and nameplates, abbreviations may be used subject to the Engineer's approval.

If a specified abbreviation does not exist for a particular word, an abbreviation may be generated using the principles of masking and or vowel deletion. Masking involves retaining the first and last letters in a word and deleting one or more characters (usually vowels) from the interior of the word.

1.06 ENVIRONMENTAL CONDITIONS

A. Instrumentation equipment and enclosures shall be suitable for ambient conditions specified. All system elements shall operate properly in the presence of telephone lines, power lines, and electrical equipment.

B. Inside control rooms and climate-controlled electrical rooms, the temperature will normally be 20 to 25 degrees C; relative humidity 40 to 80 percent without condensation and the air will be essentially free of corrosive contaminants and moisture. Appropriate air filtering shall be provided to meet environmental conditions (e.g., dust).

C. Other indoor areas may not be air conditioned/heated; temperatures may range between 0 and 40 degrees C with relative humidity between 40 and 95 percent.

D. Field equipment including instrumentation and panels may be subjected to wind, rain, lightning, and corrosives in the environment, with ambient temperatures from -20 to 40 degrees C and relative humidity from 10 to 100 percent. All supports, brackets, interconnecting hardware, and fasteners shall be aluminum, type 316 stainless steel, or metal alloy as otherwise suitable for chemical resistance within chemical feed/storage areas shown on the installation detail drawings.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.01 SCHEDULE OF PAYMENT

A. Payment to the Contractor for Control and Information System materials, equipment, and labor shall be in accordance with the General and Supplementary Conditions. The schedule of values submitted as required by the General and Supplementary Conditions shall reflect a breakdown of the work required for completion of the Control and Information System. The breakdown shall include sufficient detail to permit the Engineer to administer payment for the Control and Information System.

B. The following payment schedule defines project milestones that will be used for establishing maximum partial payment amounts for the Control and Information System. Payment for field instruments, field wiring, fiber optic network cable and similar items will be made in addition to the payment for the scopes of services incorporated into the schedule below.

1. Task Completed - Maximum Cumulative % Request for Payment

    a. Mobilization - 3%

    b. Approved Submittals - 20%

    c. Hardware Purchase (excludes field instruments) - 40%

    d. Factory Witness Test - 60%

    e. Loop Checkout - 70%

    f. Control System Start-up and Test - 80%

    g. Plant Start-up - 90%

    h. Final System Acceptance Test - 95%

    i. Final Acceptance - 100%

C. Requests for payment for materials and equipment that are not installed on site, but are required for system construction and the factory witness test (e.g., digital hardware), or are properly stored as described in the General and Supplementary Conditions and herein, shall be accompanied by invoices from the original supplier to the instrumentation subcontractor substantiating the cost of the materials or equipment.

D. Any balance remaining within the schedule of values for field instruments and other materials installed on the site, or for other materials for which payment is made by invoice, will be considered due upon completion of the Final Acceptance test.

3.02 CLEANING

A. The Contractor shall thoroughly clean soiled surfaces of installed equipment and materials.

B. Upon completion of the instrumentation and control work, the Contractor shall remove surplus materials, rubbish, and debris that has accumulated during the construction work. The entire area shall be left neat, clean, and acceptable to the Owner.

3.03 FINAL ACCEPTANCE

A. Final acceptance of the Instrumentation, Control and Information System will be determined complete by the Engineer, and shall be based upon the following:

    1. Receipt of acceptable start up completion and availability reports and other documentation as required by the Contract Documents.

    2. Completion of the Availability Demonstration.

3. Completion of control system training requirements.

4. Completion of punch-list items that are significant in the opinion of the Engineer.

B. Final acceptance of the System shall mark the beginning of the warranty period.

END OF SECTION

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SECTION 40 61 15
PROCESS CONTROL SYSTEM SUBMITTALS

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall submit for review complete Shop Drawings for all equipment in accordance with the General and Supplemental Conditions and Division 1 of the Specifications. All submittal material shall be complete, legible, and reproducible, and shall apply specifically to this project.

B. All submittal materials shall be tailored to this project by highlighting relevant items or crossing out non-applicable items. Generic submittals without identified options will be returned the Contractor without review.

C. Compliance, Deviations, and Exceptions (CD&E) Letter:

1. Where a named manufacturer/product or manufacturer is specified and a substitution or an “or equal” product is submitted, the submittal shall be accompanied by a “Compliance, Deviations, and Exceptions (CD&E) letter.” If the required submittal is submitted without the letter, the submittal will be rejected.

2. The letter shall include all comments, deviations and exceptions taken to the Drawings and Specifications by the Contractor, subcontractor (if applicable), and the equipment Manufacturer/Supplier. This letter shall include a copy of the Specification Section to which the submittal pertains. In the left margin beside each and every paragraph/item, a letter "C", "D", or "E" shall be typed or written in.

    a. The letter "C" shall be for full compliance with the requirement.

    b. The letter "D" shall be for a deviation from the requirement.

    c. The letter "E" shall be for taking exception to a requirement.

3. Any requirements with the letter "D" or "E" beside them shall be provided with a full typewritten explanation of the deviation/exception. Handwritten explanation of the deviations/exceptions shall not be acceptable.

4. The CD&E letter shall also address deviations, and exceptions taken to each Drawing related to this Specification Section.

D. Although this Section is intended to list the majority of submittals required for a given project, there may be additional submittal requirements in other Sections. Reference the applicable Sections for a given topic and include additional submittal information when required.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01 33 00 – Submittal Procedures

B. Section 40 61 13 – Process Control System General Provisions

1.03 EXISTING CONDITIONS / AS-BUILT DOCUMENTATION SUBMITTAL

A. Prior to modifying, demolishing, removing, or decommissioning equipment, thoroughly investigate and document the existing conditions. Please note that Owner's record drawings alone are not sufficient for documentation. The record drawings, if present, shall be verified in the field prior to submitting. Submit drawings, markup, sketches, information, or other materials for documenting the following existing conditions:

1. All I/O on PLC modules that have its wiring modified or new I/O terminated or for any PLC that is being decommissioned/removed/demolished. Document module number, point number, wire numbers, terminal numbers, destination, function, and whether the connected device is functioning.

2. All wiring entering or leaving an enclosure that is being decommissioned, removed, or demolished that is not otherwise accounted for.

3. Documentation of configuration settings, logic, or other customizable parameters. For PLCs, OITs, and similar, a download of its logic or application file is acceptable.

B. When all information has been gathered, it shall be submitted to Engineer along with a clear and unequivocal statement that the existing conditions have been documented and understood. Contractor shall be held responsible for all issues that arise due to Contractor's modifications, demolition, removal, or decommissioning of existing equipment, including necessary reversion back to previous conditions.

1.04 DIGITAL HARDWARE SUBMITTALS

A. Submit system block diagram(s) showing:

1. All equipment to be provided.

2. All interconnecting cable.

3. Equipment names, manufacturer, and model numbers.

4. Equipment locations.

B. Submit information for all digital equipment including, but not limited to, the following:

1. Bill of materials with equipment names, manufacturers, complete model numbers and locations.

2. Catalog cuts, including complete part number breakdown information.

3. Complete technical, material and environmental specifications.

4. Assembly drawings.

5. Mounting requirements.

6. Color samples.

7. Nameplates.

8. Environmental requirements during storage and operation.

1.05 SOFTWARE SUBMITTALS

A. Software submittals shall include the following as a minimum:

1. Bill of materials with software names, vendors, and complete listings of included software modules.

2. Standard manufacturer's literature describing the products.

3. Description of function of software in Control and Information System.

4. Limitations or constraints of software.

5. Minimum system (processor and memory) requirements.

6. Operation and maintenance requirements.

B. Submit information on the following software:

1. Third-party software, including:

a. Operating system.

b. Operator workstation (SCADA or HMI) software, including all add-in software provided to perform specific functions (alarm dialers, schedulers, backup creation software, etc.).

c. Office-type products, such as spreadsheets, word processors, etc.

d. Database management software.

e. Communication software, including all applicable local and wide area network software.

f. Programmable controller programming software (where applicable).

2. Software configuration, including:

a. Graphic display organization.

b. Database configuration for operator workstations and database management system.

c. Trends.

d. System security.

e. Formats for all reports, including all required calculations.

f. Intercommunications between software products required to implement system functions.

g. Equipment backup configuration and requirements.

C. Programming methodology submittal

1. Standard PLC programming logic, with comments, for

a. “Across-the-line” motor

b. Variable speed motor

c. Open/close valve

d. Modulating valve

e. Operator mode/stage selection with auto alternate

2. Internal PLC task/routine layout, per PLC if not standardized.

3. Standard PLC tag name structure

D. Control Strategies

1. Description of automatic logic and all non-standard manual logic using plain English, for non-technical persons, and written in Contractor’s own words. The write-up shall include references to associated I/O, tag/loop numbers, alarming/interlocks.

2. Submitting language verbatim to Section 40 61 96 – Process Control Descriptions shall not be acceptable.

E. Application Software

1. Provide application software documentation that contains program descriptions for the operation, modification, and maintenance of all application programs provided for the digital system.

2. Application software includes all custom routines developed specifically for this project, or pre-written routines used for accomplishing specified functions for this project. This shall include any add-in custom software.

F. Graphic Displays

1. Submit all graphic displays required to perform the control and operator interface functions specified herein. Submitted graphic displays shall be for both new and modified graphics.

2. Submit the complete set of graphic displays for review by the Owner and the Engineer at least 60 days prior to commencement of factory testing.

3. Where a large number of graphic displays are required, submit an initial set of example displays for review before the complete set of displays is submitted. This initial set shall include examples of all basic graphic display design features and parameters and is intended to allow the Contractor to obtain preliminary approval of these features and parameters prior to beginning main graphic display production.

4. The Contractor shall allow for one major cycle of revisions to the displays prior to factory testing and one minor cycle of revisions following factory test. A cycle of revisions shall be defined as all revisions necessary to complete a single set of changes marked by the Engineer and the Owner. Additional corrections shall be performed during start-up as required to accommodate changes required by actual field conditions, at no additional cost to the Owner.

5. The required submittals in each revision cycle shall be full color prints of the entire set of displays.

6. Displays shall be printouts of actual process graphics implemented in the system.

7. See additional requirements in Section 40 68 00 – Process Control Software.

1.06 CONTROL PANEL SUBMITTALS

A. Submittals shall be provided for all control panels, and shall include:

1. Exterior panel drawings with front and side views, to scale.

2. Interior layout drawings showing the locations and sizes of all equipment and wiring mounted within the cabinet, to scale.

3. Panel area reserved for cable access and conduit entry.

4. Location plans showing each panel in its assigned location.

5. Thermal (heating and cooling) calculations

6. Power calculations, including UPS sizing and runtime calculation, if provided.

7. Proof of over current protective device selective coordination, if requested.

B. Submit information for all exterior and interior panel mounted equipment including, but not limited to, the following:

1. Bill of materials with equipment names, manufacturers, complete model numbers and locations.

2. Catalog cuts, including complete part number breakdown information.

3. Complete technical, material and environmental specifications.

4. Assembly drawings.

5. Mounting requirements.

6. Material and color samples, where required.

7. Nameplates.

8. Environmental requirements during storage and operation.

C. Submit panel wiring diagrams showing power, signal, and control wiring, including surge protection, relays, courtesy receptacles, lighting, wire size and color coding, etc. Include remote equipment labels, remote contact/signal names, remote terminal numbers, and field conduit/cable identification.

1.07 INSTRUMENT SUBMITTALS

A. Submit information on all field instruments, including but not limited to the following:

1. Product (item) name and tag number used herein and on the Contract Drawings.

2. Catalog cuts, including complete part number breakdown information.

3. Manufacturer's complete model number.

4. Location of the device.

5. Input output characteristics.

6. Range, size, and graduations.

7. Physical size with dimensions, NEMA enclosure classification, and mounting details.

8. Materials of construction of all enclosures, wetted parts and major components.

9. Instrument or control device sizing calculations where applicable.

10. Certified calibration data on all flow metering devices.

11. Environmental requirements during storage and operation.

12. Associated surge protection devices.

13. Installation drawings/details.

14. Material samples, where required

1.08 TESTING & START-UP (MULTIPLE SUBMITTALS)

A. Test plans per Section 40 61 21 – Process Control System Testing, unless otherwise indicated.

1. Factory witness testing plan

2. Field testing plan

3. Final acceptance testing plan

4. Instrument test plan per Section 40 70 00 – Instrumentation for Process Systems

5. Blank calibration/verification sheets per Section 40 70 00 – Instrumentation for Process Systems

B. Test results per Section 40 61 21 – Process Control System Testing, unless otherwise indicated

1. Factory witness testing results

2. Field testing results

3. Final acceptance testing results

4. Completed calibration/verification sheets per Section 40 70 00 – Instrumentation for Process Systems

C. Proposed maintenance agreement per Section 40 61 24 – Quality Assurance

D. Training per Section 40 61 26 – Process Control System Training

1. Training plan for each type

2. Training documentation for each type

3. Training attendance logs

4. Recorded video documentation, if required.

1.09 WIRING AND LOOP DIAGRAMS

A. Submit interconnection wiring and loop diagrams for all panels and signals in the Control and Information System.

B. Electrical interconnection diagrams shall show all terminations of equipment, including terminations to equipment and controls furnished under other Divisions, complete with equipment and cable designations. Where applicable, interconnection wiring diagrams shall be organized by input/output card. Interconnecting diagrams shall be prepared in a neat and legible manner on 11 X 17-inch reproducible prints.

C. Loop drawings shall conform to the latest version of ISA Standards and Recommended Practices for Instrumentation and Control. Loop Drawings shall conform to ISA S5.4, Figures 1-3, Minimum Required Items.

D. Loop drawings shall not be required as a separate document provided that the interconnecting wiring diagrams required herein contain all information required by ISA.

1.10 OPERATION AND MAINTENANCE MANUALS

A. The Contractor shall deliver equipment operation and maintenance manuals in compliance with Section 01 33 00 – Submittal Procedures. Operation and maintenance (O&M) manuals shall consist of two basic parts:

1. Manufacturer standard O&M manuals for all equipment and software furnished under this Division.

2. Custom O&M information describing the specific configuration of equipment and software, and the operation and maintenance requirements for this particular project.

B. The manuals shall contain all illustrations, detailed drawings, wiring diagrams, and instructions necessary for installing, operating, and maintaining the equipment. The illustrated parts shall be numbered for identification. All modifications to manufacturer standard equipment and/or components shall be clearly identified and shown on the drawings and schematics. All information contained therein shall apply specifically to the equipment furnished and shall only include instructions that are applicable. All such illustrations shall be incorporated within the printing of the page to form a durable and permanent reference book.

C. The manuals shall be prepared specifically for this installation and shall include all required cuts, drawings, equipment lists, descriptions, etc. that are required to instruct operation and maintenance personnel unfamiliar with such equipment. The maintenance instructions shall include troubleshooting data and full preventive maintenance schedules. The instructions shall be bound in locking 3-D-ring binders with bindings no larger than

3.5 inches. The manuals shall include 15% spare space for the addition of future material. The instructions shall include drawings reduced or folded and shall provide the following as a minimum.

1. A comprehensive index.

2. A functional description of the entire system, with references to drawings and instructions.

3. A complete "as built" set of all approved shop drawings, which shall reflect all work required to achieve final system acceptance.

4. A complete list of the equipment supplied, including serial numbers, ranges, and pertinent data.

5. Full specifications on each item.

6. Detailed service, maintenance, and operation instructions for each item supplied.

7. Special maintenance requirements particular to this system shall be clearly defined, along with special calibration and test procedures.

8. Complete parts lists with stock numbers and name, address, and telephone number of the local supplier.

9. References to manufacturers' standard literature where applicable.

10. Warning notes shall be located throughout the manual where such notes are required to prevent accidents or inadvertent misuse of equipment.

D. The operating instructions shall clearly describe the step by step procedures that must be followed to implement all phases of all operating modes. The instructions shall be in terms understandable and usable by operating personnel and maintenance crews and shall be useful in the training of such personnel.

E. The maintenance instructions shall describe the detailed preventive and corrective procedures required, including environmental requirements during equipment storage and system operation, to keep the System in good operating condition. All hardware maintenance documentation shall make reference to appropriate diagnostics, where applicable, and all necessary wiring diagrams, component drawings and PCB schematic drawings shall be included.

F. The hardware maintenance documentation shall include, as a minimum, the following information:

1. Operation Information: This information shall include a detailed description of how the equipment operates and a block diagram illustrating each major assembly in the equipment.

2. Preventive Maintenance Instructions: These instructions shall include all applicable visual examinations, hardware testing and diagnostic routines, and the adjustments necessary for periodic preventive maintenance of the System.

3. Corrective Maintenance Instructions: These instructions shall include guides for locating malfunctions down to the card replacement level. These guides shall include adequate details for quickly and efficiently locating the cause of an equipment malfunction and shall state the probable source(s) of trouble, the symptoms, probable cause, and instructions for remedying the malfunction.

4. Parts Information: This information shall include the identification of each replaceable or field repairable component. All parts shall be identified on a list in a drawing; the identification shall be of a level of detail sufficient for procuring any repairable or replaceable part. Cross references between equipment numbers and manufacturer's part numbers shall be provided.

G. Software documentation shall conform to a standard format and shall include, but not be limited to, the following:

1. A program abstract that includes:

a. Program Name - The symbolic alphanumeric program name.

b. Program Title - English text identification.

c. Program Synopsis - A brief text shall be provided that specifies the need for the program, states when it shall be used and functionally describes all inputs, outputs and functions performed. This descriptive text shall be written in a language that is understandable by non-programming-oriented readers.

2. A program description that shall include, but not be limited to, the following:

a. Applicable Documents - List all documents (standard manufacturer's literature, other program descriptions, etc.) by section, if practical, that apply to the program. One complete copy of all applicable reference material shall be provided.

b. Input Output - Identify each input and output parameter, variable, and software element used by the program. State the purpose of all inputs, outputs, and variables.

c. Processing - This section shall contain a description of the overall structure and function of the program. Describe the program run stream and present a detailed description of how the program operates. Describe the timing and sequencing of operations of the program relative to other programs. Describe all interactions with other programs. Processing logic that is not readily described without considerable background information shall be handled as a special topic with references to an appendix or to control strategy document

that details the necessary information. Reference shall also be made to an appendix or control strategy document for equation and program algorithm derivations.

d. System Configuration - Describe in detail the system configuration or status required for program implementation, if appropriate.

e. Limitations and Constraints - Summarize all known or anticipated limitations of the program, if appropriate.

f. Storage - Define program storage requirements in terms of disk or RAM memory allocation.

g. Verification - Describe, as a minimum, a test that can be used by the operator to assure proper program operation. Define the required system configuration, input requirements and criteria for successful test completion.

h. Diagnostics - Describe all program diagnostics, where applicable. Descriptions shall list each error statement, indicate clearly what it means, and specify what appropriate actions should be taken.

i. Malfunction Procedures - Specify procedures to follow for recovering from a malfunction due to either operator error or other sources.

1.11 FINAL SYSTEM DOCUMENTATION

A. All documentation shall be delivered to the Owner prior to final system acceptance in accordance with the Contract Documents. As a minimum, final documentation shall contain all information originally part of the control system submittals.

B. Provide a complete set of detailed electrical interconnection diagrams required to define the complete instrumentation and control system. All diagrams shall be 11 X 17-inch original reproducible prints. All diagrams shall be corrected to describe final "as built" hardware configurations and to reflect the system configuration and control methodology adopted to achieve final system acceptance.

C. Provide system software documentation for the operation and maintenance of all system software programs provided as a part of the digital system. All system software documentation shall be amended as required to delineate all modifications and to accurately reflect the final as built software configurations.

D. Provide application software documentation that contains program descriptions for the operation, modification, and maintenance of all application programs provided for the digital system.

E. Provide control strategy documentation which shall include control strategy (block oriented or ladder logic) diagrams to describe the control of all processes. Control strategy

documentation shall reflect the system configuration and control methodology adopted to achieve final system acceptance. Control strategy documentation shall conform to the submittal requirements listed hereinabove.

F. O&M documentation shall be amended with all final, adjusted values for all setpoints and other operating parameters for Owner reference.

G. The Owner recognizes the fact that not all possible problems related to real time events, software interlocks, and hardware maintenance and utilization can be discovered during the Acceptance Tests. Therefore, the instrumentation subcontractor through the Contractor shall investigate, diagnose, repair, update, and distribute all pertaining documentation of the deficiencies that become evident during the warranty period. All such documentation shall be submitted in writing to the Owner within 30 days of identifying and solving the problem.

1.12 PROGRAMS AND SOURCE LISTINGS

A. Provide one copy of all standard, off-the-shelf system and application software (exclusive of firmware resident software) on original media furnished by the software manufacturer.

B. Provide one copy of source listings on digital media, acceptable to Engineer, for all custom software/logic written specifically for this facility, all database files configured for this facility, and all control strategies. All source listings shall include a program abstract, program linkage and input/output data. Comments describing the program flow shall be frequently interspersed throughout each listing.

C. All software/logic shall be in both its native format and in Adobe Portable Document Format.

1.13 SUBMITTAL/DOCUMENTATION FORMAT

A. All drawing-type submittals and documentation shall be rendered and submitted in the latest version of AutoCAD as well as Adobe PDF format. All Auto Cad drawings shall conform to Owner CAD standards in effect at the time of contract bidding.

B. All textual-type submittals and documentation shall be rendered and submitted in the latest version of Microsoft Word or in searchable Adobe Portable Document Format (PDF). Raster scans will not be accepted.

C. All textual-type submittals and documentation shall also be rendered and submitted in the latest version of Microsoft Word as well as Adobe PDF format.

D. All textual-type submittals and documentation shall be submitted at least with a similar format as outlined below:

1. Cover Page.

2. Table of content.

3. Section No. XX XX XX Name of the section.

   a. Sections shall group items of the same Specification Section. Example (Section: 40 66 00 Network, Section: 40 63 43 Programable Logic Controllers, etc.).

   a. The Section No. XX XX XX page shall be a blank page containing only the information of the section number. The following page shall contain a list of all devices provided under this section, listed in alphabetical order from A to Z.

   b. Every page after the Section No. XX XX XX page and the list of devices shall be a datasheet corresponding to a device as outlined in item b. above. Datasheets shall be linked to bookmarks and shall be in the same order as the list of devices provided under every section.

   c. Datasheets within every section shall be linked to a bookmark with the following format: Manufacturer: Supplied model number-Type of device.

   d. For Section: 40 67 00 – Control System Equipment Panels and Racks, provide shop drawings with bookmarks to main areas of the drawings. Example (Layout, Wiring diagrams, Biil of Materials, Instrumentation).

1.14 ELECTRONIC O&M MANUALS

A. Subject to acceptance by the Engineer, the O&M information may be submitted in part or in whole in an electronic format on digital media.

B. Electronic O&M manuals shall contain information in standard formats (searchable Adobe PDF, Word, AutoCAD, HTML, etc.) and shall be easily accessible using standard, “off-the-shelf” software such as an Internet browser. Raster scans will not be accepted.

C. O&M submittal structure shall follow the same format as the one specified on item 1.12 above, specifically tailored to this Manual.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

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SECTION 40 61 21
PROCESS CONTROL SYSTEM TESTING

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall test the Control and Information System as specified herein to demonstrate compliance with the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 40 61 13 – Process Control System General Provisions

B. Section 40 61 21.71 – Factory Witness Test

C. Section 40 61 21.72 – Field Testing

D. Section 40 61 21.73 – Final Acceptance Test

1.03 SUBMITTALS

A. For each of the specified tests, submit a test plan to the Engineer at least one month in advance of commencement of the tests. The test plan shall contain the following at a minimum:

1. A schedule of all testing to be conducted.

2. A brief description of the testing to be performed.

3. Test objectives.

4. Testing criteria per the Specifications.

5. Check lists and procedures for performing each of the specified tests.

6. Sample test result documentation.

7. Requirements for other parties.

1.04 GENERAL REQUIREMENTS

A. All system start-up and test activities shall follow detailed test procedures; check lists, etc., previously approved by the Engineer. The Engineer shall be notified at least 21 days in advance of any system tests and reserves the right to have his and/or the Owner's representatives in attendance.

B. The Contractor shall provide the services of experienced factory trained technicians, tools and equipment to field calibrate, test, inspect, and adjust all equipment in accordance with manufacturer's specifications and instructions.

C. The Contractor (or designee) shall maintain master logbooks for each phase of installation, startup and testing activities specified herein. Each logbook shall include signal, loop or control strategy tag number, equipment identification, description and space for sign-off dates, Contractor signature and Engineer signature. Example test documentation specific to each phase of testing shall be approved prior to initiation of that testing, as specified hereinabove.

D. All test data shall be recorded on test forms, previously approved by the Engineer. When each test has been successfully completed, a certified copy of all test results shall be furnished to the Engineer together with a clear and unequivocal statement that all specified test requirements have been met and that the system is operating in accordance with the Contract Documents.

E. The Engineer will review test documentation in accordance with the Contract Documents and will give written notice of the acceptability of the tests within 10 days of receipt of the test results.

F. All testing shall include time for unstructured testing where Owner and Engineer shall have access to the equipment for testing previously undefined normal and abnormal aspects, situations, and functions. Contractor or his/her designee shall provide assistance during this time, including but not limited to documenting the unstructured testing. Owner’s and Engineer’s unstructured testing scenarios may not be available prior to the testing period.

G. If, in the Engineer’s or Owner’s opinion, Contractor is not ready for witness testing and Engineer is present, Contractor shall reimburse Owner for Engineer’s labor to attend the test. Witness testing shall then be rescheduled, with sufficient notice. In the event that Engineer has traveled, even if only to the project-site, for the testing, Engineer’s travel costs shall also be reimbursed. In the event that the Owner has traveled for the testing, Owner’s travel costs shall also be reimbursed.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 40 61 21.71
FACTORY WITNESS TEST

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall perform a Factory Witness Test on the Control and Information System as specified herein to demonstrate compliance with the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 40 61 13 – Process Control System General Provisions

B. Section 40 61 21 – Process Control System Testing

C. Section 40 61 21.72 – Field Testing

D. Section 40 61 21.73 – Final Acceptance Test

1.03 FACTORY WITNESS TEST

A. The Control and Information System equipment shall not be shipped until the Contractor receives notice of acceptability of the factory tests.

B. Each item of equipment shall be fully factory inspected, calibrated and tested for function, operation and continuity of circuits. Exceptions shall be approved in writing by the Engineer.

C. Each subsystem shall be fully factory tested for function and operation.

D. System performance shall be tested using a fully integrated system, including all software and hardware. To achieve this, the entire control system, including all peripheral devices and all interconnecting cables (field instruments are not included in this requirement), shall be assembled on the factory test floor and the complete operational program loaded and simulated inputs applied.

E. All hardware and software required to perform the specified testing shall be furnished by the Contractor at no additional cost to the Owner.

F. The instrumentation subcontractor shall perform a 100-hour full system test, during which the entire system shall operate continuously without failure in accordance with the requirements of the Contract Documents. If a system component fails during the test, the 100-hour test period shall be restarted after its operation is restored.

G. The overall system as well as individual component hardware shall be tested under conditions of power failure to ensure proper response as specified herein.

H. Process I/O Simulation - Process input/output simulation for PLCs shall be performed with a manual simulation control panel, a separate programmable logic controller, network-based simulation software, analog signal generators, and/or jumpering of discrete signals between outputs and associated inputs, or some combination of these. Alternate process I/O systems such as plug-in circuit cards or I/O test modules may be utilized subject to approval by the Engineer to provide the specified simulation functions. The simulation system shall provide analog and discrete I/O hardware devices in sufficient quantity to allow complete and thorough testing of the control strategies and functions of the system. The process I/O simulation system shall be used in several ways as follows:

1. To provide a means of communications checkout from the operator workstations through the various levels of software in the PLCs and to the process, i.e., the simulation panel. Likewise, a discrete or analog input shall be initiated from the simulation panel and the result monitored at the workstations.

2. Alarm response to discrete status changes or analog value limits shall be verified. Database entries or attributes such as engineering units and conversion equations shall be verified by varying analog inputs.

3. To provide data for use at all levels of the control system at the time of system integration.

I. Control Strategy Testing

1. Provision shall be made to test all control strategies to prove the integrity of each strategy and the process control language in which it is implemented. For each control strategy, all functions shall be tested individually (where possible) and collectively to verify that the control strategy performs as described herein and as required for overall functionality within the control system.

2. The sodium hypochlorite temporary system Local Control Panel (PLC-4 RIO RACK 5) is equipped with a Remote I/O (RIO-5) intended to communicate with an existing PLC in the field. For the purpose of the Factory Witness Test, the Contractor shall provide a PLC that is fully compatible with the RIO and shall load a representative test program into it. This test program is not intended to be the final control logic but rather a simplified or mock version developed solely for the purpose of conducting the Factory Witness Test. It shall simulate, as accurately as possible, the expected system behavior, including I/O signals, control sequences, alarms, interlocks, and system responses.

3. The temporary PLC and associated test program shall be provided at no additional cost to the Owner.

4. This simulation setup shall allow complete functional testing of all hardware and software interfaces within the panel, including response to simulated process conditions and faults.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

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SECTION 40 61 21.72
FIELD TESTING

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall perform field testing on the Control and Information System as specified herein to demonstrate compliance with the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 40 61 13 – Process Control System General Provisions

B. Section 40 61 21 – Process Control System Testing

C. Section 40 61 21.71 – Factory Witness Test

D. Section 40 61 21.73 – Final Acceptance Test

E. Section 40 70 00 – Instrumentation for Process Systems

1.03 GENERAL REQUIREMENTS

A. Control system start-up and testing shall be performed to ensure that all plant processes shall be systematically and safely placed under digital control in the following order:

1. Primary elements such as transmitters and switch devices shall be calibrated and tested as specified in Section 40 70 00 – Instrumentation for Process Systems.

2. Each final control element shall be individually tested as specified hereinafter.

3. Each control loop shall be tested as specified hereinafter.

4. Each control strategy shall be tested under automatic digital control as specified hereinafter.

5. The entire control system shall be tested for overall monitoring, control, communication, and information management functions, and demonstrated for system availability as specified hereinafter.

6. All loop and calibration sheets shall be submitted prior to final loop tests performed in the presence of the Engineer.

B. System start-up and test activities shall include the use of water, if necessary, to establish service conditions that simulate, to the greatest extent possible, normal operating

conditions in terms of applied process loads, operating ranges and environmental conditions.

C. Each phase of testing shall be fully and successfully completed and all associated documentation submitted and approved prior to the next phase being started. Specific exceptions are allowed if written approval has been obtained in advance from the Engineer.

D. All chemical storage tank radar level transmitters units, and all storage tank level alarm switches shall be fully tested for proper operation with clean water. The testing shall occur prior to the seven (7) day test, prior to the introduction of chemical into storage tanks, prior to functional testing of the control sequence, but after loop checks. Each clean water test shall be witnessed and approved by the Engineer in writing. The Contractor and Instrumentation Subcontractor shall conduct a complete pre-test and shall submit a test report along with trend data to the Engineer prior to scheduling the Engineer witnessed test and shall provide a minimum of two weeks' notice to Engineer to witness the test. The test shall be conducted independent of other system tests and shall not be combined with any other Engineer witnessed tests. Failed tests shall be repeated by the Contractor at no additional cost to Owner and shall be rescheduled based on Engineer availability.

E. Each phase of testing shall be fully and successfully completed, and all associated documentation submitted and approved prior to the next phase being started. Specific exceptions are allowed if written approval has been obtained in advance from the Engineer.

1.04 CONTRACTOR'S RESPONSIBILITIES

A. The Contractor shall ensure that all mechanical equipment, equipment control panels, local control panels, field instrumentation, control system equipment and related equipment and/or systems are tested for proper installation, adjusted and calibrated on a loop-by-loop basis prior to control system startup to verify that each is ready to function as specified. Each test shall be witnessed, dated and signed off by both the Contractor (or designee) and the Engineer upon satisfactory completion.

B. The Contractor shall be responsible for coordination of meetings with all affected trades. A meeting shall be held each morning to review the day's test schedule with all affected trades. Similarly, a meeting shall be held each evening to review the day's test results and to review or revise the next day's test schedule as appropriate.

C. The Contractor shall ensure that the electrical subcontractor conforms to the start-up, test and sign-off procedures specified herein to assure proper function and coordination of all motor control center control and interlock circuitry and the transmission of all discrete and/or analog signals between equipment furnished by the electrical subcontractor and the control system specified herein.

D. The Contractor shall ensure that the HVAC subcontractor conforms to the start-up, test and sign-off procedures specified herein to assure proper function of all HVAC system

control and interlock circuitry and the transmission of all discrete and/or analog signals between HVAC equipment and controls and the control system specified herein.

1.05 FINAL CONTROL ELEMENT TESTING

A. The proper control of all final control elements shall be verified by tests conducted in accordance with the requirements specified herein.

B. All modulating final control elements shall be tested for appropriate speed or position response by applying power and input demand signals and observing the equipment for proper direction and level of reaction. Each final control element shall be tested at 0, 25, 50, 75, and 100 percent of signal input level and the results checked against specified accuracy tolerances. Final control elements, such as VFDs, that require turndown limits shall be initially set during this test.

C. All non-modulating final control elements shall be tested for appropriate position response by applying and simulating control signals and observing the equipment for proper reaction.

1.06 LOOP CHECKOUT

A. Prior to control system startup and testing, each monitoring and control loop shall be tested on an individual basis from the primary element to the final element, including the operator workstation or loop controller level, for continuity and for proper operation and calibration.

B. Signals from transducers, sensors, and transmitters shall be utilized to verify control responses. Simulated input data signals may be used subject to prior written approval by the Engineer. All modes of control shall be exercised and checked for proper operation.

C. The accuracy of all DACs shall be verified by manually entering engineering unit data values at the operator workstation and then reading and recording the resulting analog output data.

D. The accuracy of all ADCs shall be verified using field inputs or by manually applying input signals at the final controller and then reading and recording the resulting analog input data at the operator workstation.

E. Each loop tested shall be witnessed, dated and signed off by both the Contractor (or designee) and the Engineer upon satisfactory completion.

1.07 CONTROL SYSTEM STARTUP AND TESTING

A. Control system startup and testing shall be performed to demonstrate complete compliance with all specified functional and operational requirements. Testing activities shall include the simulation of both normal and abnormal operating conditions.

B. All digital hardware shall be fully inspected and tested for function, operation and continuity of circuits. All diagnostic programs shall be run to verify the proper operation of all digital equipment.

C. Final control elements and ancillary equipment shall be tested under start-up and steady-state operating conditions to verify that proper and stable control is achieved using local area control panels, motor control center circuits, and local field mounted control circuits. All hardwired control circuit interlocks and alarms shall be operational. The control to final control elements and ancillary equipment shall be tested using both manual and automatic (where provided) control circuits.

D. Signals from transducers, sensors, and transmitters shall be utilized to verify control responses for final control elements. Simulated input data signals may be used subject to prior written approval by the Engineer.

E. Each control strategy shall be tested to verify the proper operation of all required functions. The control system start-up and test activities shall include procedures for tuning all control loops incorporating PID control modules, and for adjusting and testing all control loops as required to verify specified performance.

F. The control system start-up and test activities shall include running tests to prove that the Instrumentation, Control and Information System is capable of continuously, safely and reliably regulating processes, as required by the Contract, under service conditions that simulate, to the greatest extent possible, normal plant operating ranges and environmental conditions.

G. A witnessed functional acceptance test shall be performed to demonstrate satisfactory performance of individual monitoring and control loops and control strategies. At least one test shall be performed to verify that the control and instrumentation system is capable of simultaneously implementing all specified operations.

H. Each loop and control strategy test shall be witnessed and signed off by both the Contractor (or designee) and the Engineer upon satisfactory completion.

1.08 FACILITY STARTUP COORDINATION

A. Facility start-up shall comply with requirements specified in the Contract Documents and those requirements specified herein. Facility start-up shall commence after all previously described start-up and test activities have been successfully completed and shall demonstrate that the Instrumentation, Control and Information System can meet all Contract requirements with equipment operating over full operating ranges under actual operating conditions.

B. The control system start-up period shall be coordinated with process startup activities and shall be extended as required until all plant processes are fully operational and to satisfy the Engineer that all control system Contract requirements have been fulfilled in accordance with the Contract Documents.

C. The instrumentation subcontractor's personnel shall be resident at the facility to provide both full time (eight hours/day, five days/week) and 24 hours on call (seven days/week) support of operating and maintenance activities for the duration of the start-up period.

D. At least one qualified control systems technician shall be provided for control system startup and test activities and at least two when loop checkout is being performed.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

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SECTION 40 61 21.73
FINAL ACCEPTANCE TEST

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall perform the Final Acceptance Test on the Control and Information System as specified herein to demonstrate compliance with the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 40 61 13 – Process Control System General Provisions

B. Section 40 61 21 – Process Control System Testing

C. Section 40 61 21.71 – Factory Witness Test

D. Section 40 61 21.72 – Field Testing

1.03 AVAILABILITY DEMONSTRATION AND FINAL SYSTEM ACCEPTANCE

A. Upon completion of all control system startup activities and prior to final system acceptance, the Contractor shall demonstrate that the availability of the entire control system, including operation under conditions of digital equipment fail-over, initiated either automatically or manually, shall be not less than 99.8 percent during a 30-day availability test period. The Owner shall be given two (2) weeks' notice of the starting date of the 30-day availability test.

B. For purposes of determining availability figures, downtime of each system or portions of each system resulting from the causes specified hereunder will not be considered system failures.

1. Downtime of any network-connected device that is automatically backed-up upon failure shall not be considered a system failure provided that the downtime of the failed component does not exceed 24 hours.

2. Downtime of a portion of the system resulting from failure of any field sensor shall not be considered a system failure provided that the system operates as specified under this condition.

3. Downtime of the following devices shall not be considered a system failure provided the failed device is repaired within the specified time:

a. Hard disc (one day)

b. Workstations (one day)

c. Communication interfaces (eight hours)

d. Printer (three days)

e. Process control system networks (eight hours)

f. Off-line (optical, etc.) storage units (one day)

g. UPS unit (one day)

4. Total shutdown of a single PLC resulting from a software fault shall be considered a system failure.

5. An erroneous command to the process that can be specifically related to a software fault shall be considered as one (1) hour of downtime.

6. The inoperability of any subsystem resulting from a software fault shall be considered a system failure.

7. The failure of the same component more than one time during the 30-day test shall be considered a system failure.

C. If the system fails the 30-day availability test, the 30-day test period shall be restarted after the failed component or software is repaired/replaced and full operation is restored. The system shall be demonstrated for the full 30-day period following the restart.

D. The Contractor shall submit an availability demonstration report that shall state that all system availability requirements have been met.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 40 61 22
TOOLS, SUPPLIES, AND SPARE PARTS, GENERAL

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall provide tools, supplies, and spare parts as specified herein for the operation and maintenance of the Control and Information System.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 40 61 13 – Process Control System General Provisions

PART 2 – PRODUCTS

2.01 TOOLS

A. Furnish special tools, other than those normally found in an electronic technician's tool box, required to test, diagnose, calibrate, install, wire, connect, disconnect, assemble and disassemble any digital equipment, instrument, panel, rack, cabinet or console mounted equipment for service and maintenance. This shall include, but not be limited to, the following: connector pin insertion and removal tools, wire crimping tools, special wrenches, special instrument calibrators, indicator lamp insertion and removal tools, etc.

B. Furnish tools and test equipment together with items such as instruction manuals, carrying/storage cases, unit battery charger where applicable, special tools, calibration fixtures, cord extenders, patch cords and test leads, which are not specified but are necessary for checking field operation of equipment supplied under this Division.

2.02 SUPPLIES

A. The Contractor shall provide supplies as needed or as required by the Owner during the specified warranty period. Supplies include items such as instrument calibration chemicals, cleaning solutions, or other consumables required for proper operation or maintenance of the supplied equipment for up to one year. The Contractor shall also provide supplies as specifically required in other Sections of Division 40.

2.03 SPARE PARTS

A. Furnish spare parts for items of control and instrumentation equipment as recommended by the manufacturer and in accordance with the Contract Documents.

B. Furnish all spares in moisture-proof boxes designed to provide ample protection for their contents. Label all boxes to clearly identify contents and purpose.

C. The Contractor shall replace all spare parts consumed during installation, testing, start-up, the system availability demonstration, and the guarantee period.

D. Refer to individual digital hardware and instrument sections for additional requirements specific to those devices.

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 40 61 23
SIGNAL COORDINATION REQUIREMENTS

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall conform to the signal coordination requirements specified herein.

B. The Contractor shall be responsible for coordinating signal types and transmission requirements between the various parties providing equipment under this Contract. This shall include, but not be limited to, distribution of appropriate shop drawings among the equipment suppliers, the electrical subcontractor, the HVAC subcontractor, and the instrumentation subcontractor.

C. Analog signals shall be signals for transmitting process variables, etc. from instruments and to and from panels, equipment PLCs and Control System PLCs.

D. Discrete signals shall consist of contact closures or powered signals for transmitting status/alarm information and control commands between starters, panels, equipment PLCs, the Control System, etc.

1.02 ANALOG SIGNAL TRANSMISSION

A. Signal transmission between electric or electronic instruments, controllers, and all equipment and control devices shall be individually isolated, linear 4-20 milliamperes and shall operate at 24 VDC.

B. Signal output from all transmitters and controllers shall be current regulated and shall not be affected by changes in load resistance within the unit's rating.

C. All cable shields shall be grounded at one end only, at the control panel, with terminals bonded to the panel ground bus.

D. Analog signal isolation and conversion shall be provided where necessary to interface with instrumentation, equipment controls, panels, and appurtenances.

E. Non-standard transmission systems such as pulse duration, pulse rate, and voltage regulated shall not be permitted except where specifically noted in the Contract Documents. Where transmitters with nonstandard outputs do occur, their outputs hall be converted to an isolated, linear, 4-20 milliampere signal.

F. The Contractor shall provide 24 V power supplies for analog signals and instruments where applicable and as required inside panels, controls, etc.

G. Where two-wire instruments transmit directly to the Control and Information System, the instrumentation subcontractor shall provide power supplies at the PLC-equipped control panels for those instruments.

H. Where four-wire instruments with on-board loop power supplies transmit directly to the Control and Information System, the instrumentation subcontractor shall provide necessary signal isolators or shall otherwise isolate the input from the Control and Information System loop power supply. Similar provisions shall be made when a third element such as a recorder, indicator, or single loop controller with integral loop power supply is included in the loop.

1.03 DISCRETE INPUTS

A. All discrete inputs to equipment and Control and Information System PLCs, from field devices, starters, panels, etc., shall be unpowered (dry) contacts in the field device or equipment, powered from the PLCs, unless specified otherwise.

B. Sensing power (wetting voltage) supplied by the PLC shall be 24 VDC.

1.04 DISCRETE OUTPUTS

A. All discrete outputs from local control panels and Control and Information System PLCs to field devices, starters, panels, etc., shall be 24 VDC powered (sourced) from PLCs.

B. PLC powered discrete outputs shall energize 24 VDC pilot relay coils in the field devices, starters, panels, etc. which in turn open or close contacts in the associated control circuit. The 24 VDC relay coil, contacts, and associated control circuitry shall be furnished integral with the field device, starter, panel, etc. by the supplier and contractor furnishing the field device, starter, or panel.

C. Where required or specified herein, discrete outputs from equipment and Control and Information System PLC's to field devices, starters, panels, motor operated valves, etc., shall be dry contact or relay outputs.

D. Outputs to solenoid valves shall be 120 VAC, powered from the PLC or control panel unless specified or shown otherwise.

1.05 OTHER DISCRETE SIGNALS

A. Discrete signals between starters, panels, etc. where no 24 VDC power supply is available may be 120 VAC, as long as such contacts are clearly identified in the starter, panel, etc. as being powered from a different power supply than other starter/panel components.

B. Where applicable, warning signs shall be affixed inside the starter, panel, etc. stating that the panel is energized from multiple sources.

C. Output contacts in the starter, panel, etc., that are powered from other locations shall be provided with special tags and/or color-coding. Disconnecting terminal strips shall be provided for such contacts.

D. The above requirements shall apply to all starters and panels, regardless of supplier.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

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SECTION 40 61 24
QUALITY ASSURANCE

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. It is the intent of these Specifications and Drawings to secure high quality in materials, equipment and workmanship in order to facilitate operations and maintenance of the facility. The Contractor shall provide equipment and services to meet this intent.

1.02 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. All Work shall be installed in accordance with the National Electric Code, National Electric Safety Code, OSHA, State/Commonwealth, local and other applicable codes.

1.03 QUALITY ASSURANCE - GENERAL

A. All equipment and materials shall be new and the products of reputable recognized suppliers having adequate experience in the manufacture of these particular items.

B. For uniformity, only one manufacturer and model will be accepted for each type of product. Where differing models are required, equipment from a single manufacturer shall be provided.

C. Equipment shall be designed for the service intended and shall be of rugged construction, of ample strength for stresses that may occur during fabrication, transportation, and erection as well as during continuous or intermittent operation. They shall be adequately stayed, braced and anchored and shall be installed in a neat and workmanlike manner. Appearance and safety, as well as utility, shall be given consideration in the design of details.

D. All components and devices installed shall be standard items of industrial grade, unless otherwise noted, which shall be of sturdy and durable construction and be suitable for long, trouble-free service.

E. Electronic components shall be de-rated to assure dependability and long-term stability.

F. Printed circuit boards in field mounted equipment shall be suitable for the specified environmental conditions.

G. Alignment and adjustments shall be non-critical, stable with temperature changes or aging and accomplished with premium grade potentiometers.

H. Components of specially selected values shall not be inserted into standard electronic assemblies in order to meet the performance requirements of this specification.

1.04 OPTIONAL EQUIPMENT

A. Optional or substituted equipment or both requiring changes in details or dimensions required to maintain structural, mechanical, electrical, control, operating, maintenance or design features incorporated in these Specifications and Drawings shall be made at no additional cost to the Owner. In the event that the changes are necessary, calculations and drawings showing the proposed revisions shall be submitted for approval. The Contractor shall coordinate changes with other affected trades and contracts and pay additional charges incurred.

1.05 GUARANTEE

A. The instrumentation subcontractor through the Contractor shall install, maintain and guarantee the Instrumentation, Control and Information System as specified under the General Conditions and Division 01 of the Specifications. Maintenance personnel provided by the instrumentation subcontractor shall instruct the Owner's personnel in the operation, adjustment, calibration and repair of the equipment being serviced. Preventive and corrective activities shall be documented with service reports, which shall identify the equipment being serviced, state the condition of the equipment, describe Work performed and list materials used. A copy of service reports shall be delivered to the Owner on the day the Work is performed.

B. The instrumentation subcontractor shall provide the services of factory-trained service technician(s) at least twice during the guarantee period, for the purpose of performing preventive hardware maintenance.

C. Corrective hardware and software maintenance during the guarantee period shall be performed in accordance with the requirements of Division 01 and, in addition, shall meet the following requirements:

1. Corrective hardware maintenance shall be performed by factory-trained service technician(s) specifically trained to service the digital equipment provided. Technicians possessing suitable training and experience shall be provided to perform corrective maintenance on other equipment. The hardware service technician(s) shall be available on-site within 24 working hours after notification by the Owner.

2. Corrective software maintenance shall be performed for software provided by the instrumentation subcontractor and incorporated into the system prior to the completion of system commissioning. Software service programmer(s) shall be available for consultation within four business hours and, if required, on-site within 16 business hours after notification by the Owner. Corrective software maintenance shall include the supply, installation and startup of application software upgrades released during the guarantee period.

3. Corrective hardware and software maintenance performed during the guarantee period shall be performed at no cost to the Owner.

4. As used herein, the term "working hours" shall be defined as those of the treatment facility (seven days per week, 24 hours per day). The term "business hours" shall be defined as the hours between 8:00 a.m. and 5:00 p.m., local time, Monday through Friday; excluding holidays.

5. The guarantee period shall commence upon final acceptance of the completed treatment facility in accordance with the provisions of the Contract Documents.

D. The instrumentation subcontractor shall submit to the Owner a proposed maintenance agreement incorporating the following features:

1. Extension of preventive hardware maintenance services as described above for a period of up to five years from the expiration of the warranty period.

2. Provisions for corrective hardware or software maintenance Work on a will-call basis for a period of up to five years from the expiration of the warranty period. Corrective maintenance Work shall be performed by properly trained personnel as described above.

E. The proposed agreement shall include provisions for payment based upon an annual fee for preventive maintenance and cost plus expenses for corrective maintenance Work. The portion dealing with corrective maintenance shall be written to include corrective maintenance caused by actions of the Owner during the warranty period and shall contain clauses for re-negotiation of contract prices based upon changes in recognized economic indicators published by the United States Department of Commerce.

1.06 SHIPPING HANDLING AND STORAGE

A. In addition to shipping, handling and storage requirements specified elsewhere in the Contract Documents, air conditioning/heating shall be provided for storage of field instrumentation, panels, digital equipment and ancillary devices to maintain temperatures between 20 and 25 degrees C and relative humidity 40 to 60 percent without condensation. The air shall be filtered and free of corrosive contaminants and moisture.

1.07 FABRICATION

A. Fabrication of equipment shall conform to the codes and standards outlined in this Section, and other portions of the Contract Documents.

B. The Engineer may inspect the fabricated equipment at the factory before shipment to job site. The Contractor shall provide the Engineer with sufficient prior notice so that an inspection can be arranged at the factory. Inspection of the equipment at the factory by the Engineer will be made after the manufacturer has performed satisfactory checks, adjustments, tests and operations.

C. Equipment approval at the factory only allows the equipment to be shipped to the project site. The Contractor shall provide for the proper storage, installation and satisfactory

start-up and operation of the equipment to the satisfaction of the equipment manufacturer, the instrumentation subcontractor, and the Engineer.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.01 INSTALLATION

A. Instrumentation and control system installation Work, whether new construction or modifications to existing equipment/panels/structures, shall conform to the codes and standards outlined in this Section, and other portions of the Contract Documents.

B. The instrumentation subcontractor shall assign a competent representative who shall provide full time coordination and supervision of on-site instrumentation and control system construction Work from commencement of construction through completion and final acceptance.

C. Labor shall be performed by qualified craftsmen in accordance with the standards of workmanship in their profession and shall have had a minimum of three years of documented experience on similar projects.

D. Equipment and materials shall fit properly in their installations. Work required to correct improperly fit installations shall be performed at no additional expense to the Owner.

E. Work shall be performed in a neat and workmanlike manner. Hardware and instrumentation shall be installed in accordance with requirements specified herein, in accordance with industry best practices, in accordance with manufacturers' recommendations, and in a manner suitable for ease of operation, inspection, and maintenance. Wiring shall be neatly bundled, run in wireway, and terminated. Spare wiring shall be neatly coiled and clearly labeled at both ends for future use by the Owner. Work not meeting these requirements shall be corrected at no expense to the Owner.

F. Sufficient common-mode and differential-mode noise rejection shall be provided to ensure proper operation of the plant process control system. General practices shall include:

1. Maintaining crossings between noisy wires and signal wires at right angles.

2. Maintaining separation between noisy wires and signal wires as wide as practical.

3. Grounding all signals, shields and power supplies at the process control unit or local control panel.

4. Providing passive filters on signals with time constant compatible with scan intervals and overvoltage protection.

5. Eliminating cable splices. Splices in instrumentation and control system signal, network, and instrument manufacturer furnished cables shall be approved in advance by the Engineer.

6. Providing a floating output for transmitters that have their own power sources.

G. DC and AC power grounding shall be performed in accordance with the digital hardware manufacturer's recommendations as well as all applicable code requirements.

H. The case of each field instrument and control panel shall be grounded in compliance with the National Electric Code.

I. Power wires shall be separated from parallel-running signal wires by the following minimum spacing:

1. 120 VAC: 12 in

2. 240 VAC: 18 in

3. 480 VAC: 18 in

4. 2000 VAC and above: 24 in

J. The Contractor shall provide all required cutting, drilling, inserts, supports, bolts, and anchors, and shall securely attach all equipment and materials to their supports. Embedded supports for equipment furnished under this Division shall be provided and installed as shown specified herein and shown on the Drawings.

K. Following acceptance of the factory tests by the Engineer, and in accordance with the construction schedule, the Contractor shall commence installation of the digital control system hardware. Digital system equipment items shall not be installed, however, until all architectural, mechanical, HVAC and electrical Work has been completed in the equipment rooms, MCCs, control rooms and all structural and mechanical Work has been completed within 50 feet of equipment locations.

L. Upon completion of the above construction Work, the Contractor shall request an inspection of the above-named areas. The Engineer will issue a written approval to proceed with delivery and installation only after being satisfied that all Work described above has been properly performed. Digital equipment shall remain at the factory site or storage prior to approval for delivery to the project site. Partial shipments may be required to meet construction schedule requirements.

END OF SECTION

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SECTION 40 61 26
PROCESS CONTROL SYSTEM TRAINING

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. To familiarize the Owner's personnel with the process control system and field instrumentation, training shall be provided as detailed hereunder.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 40 61 13 – Process Control System General Provisions

1.03 SUBMITTALS

A. A minimum of 60 days prior to beginning training, submit a detailed training plan describing the following:

1. A listing of all courses to be conducted.

2. Course content.

3. Applicability of each course to management, operations, maintenance, laboratory, etc., personnel.

4. Course schedules.

5. Qualifications and experience of individual(s) providing training.

B. A minimum of 14 days prior to beginning each training course, submit documentation for use by the Owner's personnel during training. The training documentation shall be specific to the particular course, and shall include the following:

1. A listing of all subjects to be covered.

2. Course schedule.

3. Documentation/lesson plans covering all subjects to be covered during the course instruction. Information shall be in a "how to" format, with sufficient background documentation and references to manufacturer literature to provide a thorough and clear understanding of the materials to be covered.

1.04 GENERAL REQUIREMENTS

A. All costs of providing the training courses shall be borne by the Contractor.

B. As used herein, the term "day" shall mean an eight-hour day, and the term "week" shall mean a five-day, 40-hour week.

C. Training courses, especially those for operator training, may be required to be scheduled during non-standard business hours (i.e., not between the hours of 8:00 am and 5:00 pm) to accommodate the working schedule of the Owner's personnel. No additional compensation will be awarded to the Contractor for training at non-standard hours.

D. All training courses shall complement the experience and skill levels of the Owner's personnel.

E. Training courses shall be structured in order of increasing capability or security levels. The purpose of this requirement is to allow personnel with lesser training requirements or security password levels to drop out of the training at certain times while the training continues for personnel with greater requirements or higher security levels.

F. All training courses shall include lecture as well as "hands on" experience for each of the attending personnel. The Contractor shall provide sufficient equipment for this to be accomplished. For example, training in which the instructor uses the computer and the Owner's personnel passively observe as the instructor demonstrates system functions shall not be acceptable.

G. Unless otherwise specified, all training courses shall be conducted in the Owner's facilities.

H. All training shall be completed prior to system acceptance.

I. Standard manufacturer training courses are acceptable pending approval by the Engineer and Owner.

1.05 OPERATOR TRAINING

A. Two 1/2-day courses (four-hour sessions) for up to ten persons each shall be conducted to provide instruction in the use of the Control and Information System to monitor and control the facility. Training sessions shall occur on different days to accommodate shift personnel.

B. Operator training shall include familiarization training covering the Control and Information System. Operators shall be instructed in the names, locations, functions, and basic operation of all items of digital equipment and associated software.

C. Operator training shall cover process and equipment operation both individually and collectively as an operating system. Normal as well as abnormal operating conditions shall

be covered, including the response to failure occurrences and system alarms. All operator/system interactions shall be described.

D. Operators shall be trained to instruct other operators and shall be provided with all course materials.

1.06 MAINTENANCE TRAINING

A. A one-day course shall be conducted for up to four persons prior to the start-up of digital equipment at the Owner's plant. Instruction shall be provided in the following:

1. Operating all digital equipment, including system start-up and shutdown procedures.

2. The use of hardware diagnostic routines, test equipment and test procedures as required to enable the Owner's personnel to detect and isolate system faults to the circuit board or module level and to implement repairs by replacing failed circuit boards or modules.

3. Calibration and routine maintenance procedures for all analog and digital equipment.

B. Step by step written procedures shall be provided for all preventive maintenance tasks and for identifying hardware faults to the circuit board or module level for all items of digital equipment.

C. All digital equipment preventive and corrective maintenance training activities shall be limited to the use of commercially available off-the-shelf test equipment and to the use of diagnostic routines and hardware items which are the same as those to be provided as part of the system.

1.07 INSTRUMENT TRAINING

A. A one-day course shall be provided at the Owner's facilities no more than 30 days prior to system start-up to instruct a minimum of five persons each in the calibration and preventive maintenance of the field instruments provided under this Contract.

1.08 PLC TRAINING

A. One two-day course of specific training shall be provided by the instrumentation subcontractor in the use and modification of all control strategies provided under this Division.

1.09 GENERAL REFRESHER TRAINING

A. A one-day general refresher training course shall be provided for up to ten persons 3-6 months after final system acceptance. Instruction shall be given in all aspects of the

complete instrumentation and control system. Instructor(s) shall be capable of answering questions related to all aspects and details of the complete system.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 40 61 90
SCHEDULES AND CONTROL DESCRIPTIONS, GENERAL

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish, test, install and place in satisfactory operation all hardware and software required to provide the Control and Information System as specified herein and as shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 40 61 91 – Process Control System Instrument List

B. Section 40 61 93 – Process Control System Input/Output List

C. Section 40 61 96 – Process Control Descriptions

PART 2 – CONVENTIONS

2.01 PLANT NUMBERING SYSTEM

The plant equipment numbering system is based on the existing equipment tags, which range from 5 to 6 digits, and must comply with the City's standard tagging system to ensure consistency and alignment.

PART 3 – EXECUTION (NOT USED)

END OF SECTION

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SECTION 40 61 91
PROCESS CONTROL SYSTEM INSTRUMENT LIST

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish, test, install and place in satisfactory operation all instrumentation as herein specified and as shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 40 61 90 – Schedules and Control Descriptions, General

B. Section 40 61 93 – Process Control System Input/Output List

C. Section 40 61 96 – Process Control Descriptions

PART 2 – PRODUCTS

2.01 NAMEPLATES

A. Items of equipment listed in the instrument schedule, control panels, and digital hardware items shall be identified with nameplates. Each nameplate shall be located so that it is readable from the normal observation position and is clearly associated with the device or devices it identifies. Nameplates shall be positioned so that removal of the device for maintenance and repair shall not disturb the nameplate. Nameplates shall include, as necessary, the equipment identification number, description, calibrated range, and set point(s). Abbreviations of the description shall be subject to the Engineer's approval.

B. Nameplates shall be made of 1/16-inch thick machine engraved laminated phenolic plastic having white numbers and letters not less than 3/16-inch high on a black background. Nameplates attached to instruments may be black laser etched 1/8-inch high text on stainless steel with sharp edges made smooth. Stamped text shall not be acceptable.

C. Nameplates shall be attached to metal equipment by NEMA rated stainless steel screws and to other surfaces by an epoxy-based adhesive that is resistant to oil and moisture. In cases where the label cannot be attached by the above methods, it shall be drilled and attached to the associated device by means of a braided stainless steel wire affixed with a permanent crimp.

D. Submit sample nameplate of each type.

PART 3 – INSTRUMENT SCHEDULE

3.01 REQUIREMENTS

A. Refer to Table 40 61 91A following this section for a listing of the furnished instrumentation.

END OF SECTION

TABLE 40 61 91A
INSTRUMENT SCHEDULE

TAG No.	SERVICE DESCRIPTION	STATE/SPAN	P&ID	REMARKS
SECTION - 40 72 23.01 - RADAR LEVEL METERS - Two Wire				
LT-65411	BULK STORAGE TANK No. 1 (TK-65411) - LEVEL SENSOR/TRANSMITTER	0 - 12.33 ft	I-03	
LT-65412	BULK STORAGE TANK No. 2 (TK-65412) - LEVEL SENSOR/TRANSMITTER	0 - 12.33 ft	I-03	
LT-65413	BULK STORAGE TANK No. 3 (TK-65413) - LEVEL SENSOR/TRANSMITTER	0 - 12.33 ft	I-03	
LT-65414	BULK STORAGE TANK No. 4 (TK-65414) - LEVEL SENSOR/TRANSMITTER	0 - 12.33 ft	I-03	
LT-65415	BULK STORAGE TANK No. 5 (TK-65415) - LEVEL SENSOR/TRANSMITTER	0 - 12.33 ft	I-03	
LT-65416	BULK STORAGE TANK No. 6 (TK-65416) - LEVEL SENSOR/TRANSMITTER	0 - 12.33 ft	I-03	
SECTION - 40 72 73 - SIGHT LEVEL GAUGES				
LG-65411	BULK STORAGE TANK No. 1 (TK-65411) - LEVEL GAUGE	0 - 12.33 ft	I-03	
LG-65412	BULK STORAGE TANK No. 2 (TK-65412) - LEVEL GAUGE	0 - 12.33 ft	I-03	
LG-65413	BULK STORAGE TANK No. 3 (TK-65413) - LEVEL GAUGE	0 - 12.33 ft	I-03	
LG-65414	BULK STORAGE TANK No. 4 (TK-65414) - LEVEL GAUGE	0 - 12.33 ft	I-03	
LG-65415	BULK STORAGE TANK No. 5 (TK-65415) - LEVEL GAUGE	0 - 12.33 ft	I-03	
LG-65416	BULK STORAGE TANK No. 6 (TK-65416) - LEVEL GAUGE	0 - 12.33 ft	I-03	
SECTION - 40 72 76.26 - LEVEL SWITCHES				
LSH-65410-A	CHEMICAL CONTAINMENT SUMP NO. 1 - HIGH LEVEL SWITCH	ON/OFF	I-03	
LSH-65410-B	CHEMICAL CONTAINMENT SUMP NO. 2 - HIGH LEVEL SWITCH	ON/OFF	I-03	
LSH-56016	REMOTE DOSIGN POINT SUMP NO. 1 - HIGH LEVEL SWITCH	ON/OFF	I-08	
LSH-56015	REMOTE DOSIGN POINT SUMP NO. 2 - HIGH LEVEL SWITCH	ON/OFF	I-08	
SECTION - 40 71 79.16 - FLOW SWITCHES (THERMAL)				
FSL-56001	TRANSFER PUMP (TP-56001) - LOW FLOW SWITCH (SUCTION SIDE)	ON/OFF	I-07	FIELD ADJUSTABLE
SECTION - 40 71 39 - PADDLE WHEEL INSERTION FLOWMETERS				

TAG No.	SERVICE DESCRIPTION	STATE/SPAN	P&ID	REMARKS
FI-56012	NON POTABLE WATER CCT FLOW INDICATION			BATTERY OPERATED
FI-56016	REUSE WATER CCT FLOW INDICATION			BATTERY OPERATED
FI-56015	OUTFALL DOSING STATION FLOW INDICATION			BATTERY OPERATED

SECTION 40 61 93
PROCESS CONTROL SYSTEM INPUT / OUTPUT LIST

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish, test, install and place in satisfactory operation all control system inputs and outputs (I/O) as herein specified. The Contractor shall furnish, test, install and place in satisfactory operation all control system I/O as shown on the Drawings.

B. This list is intended to be complete although inadvertent errors may have been made. Contractor shall be responsible for providing any and all I/O required for a complete and working system that may have not been accounted for in the initial design.

C. Where I/O is shown or specified for an existing PLC and no new I/O modules are shown, existing spare I/O points shall be identified and used.

D. Not all networked I/O is scheduled. See individual equipment specifications for more information.

E. All I/O shall be arranged per the requirements of Section 40 63 43 – Programmable Logic Controllers, unless otherwise indicated.

F. All PLC data shall be made available to the SCADA HMI via its data link using similar tag names and numbers to facilitate consistency between the PLC and SCADA databases.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 40 61 90 – Schedules and Control Descriptions, General

B. Section 40 61 91 – Process Control System Instrument List

C. Section 40 61 96 – Process Control Descriptions

D. Section 40 63 43 – Programmable Logic Controllers

PART 2 – CONTROL SYSTEM INPUT / OUTPUT LISTS

2.01 LEGEND

A. Input/Output types (“Type”) are as follows:

1. DI – Hardwired Discrete Input

2. DO – Hardwired Discrete Output

3. AI – Hardwired Analog Input

4. AO – Hardwired Analog Output

2.02 COMMON PLC INPUTS

A. The inputs listed in the table below shall be included for PLC4 RIO RACK 5 control panel.

Tag ID	Description	Type	State/Range	Comments
	Loop DC Power Supply No. 1	DI	Failure	
	Loop DC Power Supply No. 2	DI	Failure	
	UPS on UPS Power (Utility Lost)	DI	Fault	
	UPS Common Fault	DI	Fault	
	Surge Protection System - Group x	DI	Warning	Provide for x groups (up to 28 devices/group)
	Surge Protection System - Group x	DI	Overload	Provide for x groups (up to 28 devices/group)
	Panel Door	DI	Intrusion	
	Panel Air Temperature	AI	32-140 deg F	

2.03 ATTACHMENTS

A. See attached Table 40 61 93A Input/Output List following this section.

PART 3 – EXECUTION (NOT USED)

END OF SECTION

TABLE 40 61 93A
INPUT/OUTPUT SCHEDULE

TAG	SERVICE DESCRIPTION	PLC	I/O TYPE	P&ID	NOTES
ANALOG INPUTS					
LI-65411	BULK STORAGE TANK No. 1 (TK-65411)-LEVEL	RIO-5 (PLC-4)	AI	I-03	
LI-65412	BULK STORAGE TANK No. 2 (TK-65412)-LEVEL	RIO-5 (PLC-4)	AI	I-03	
LI-65413	BULK STORAGE TANK No. 3 (TK-65413)-LEVEL	RIO-5 (PLC-4)	AI	I-03	
LI-65414	BULK STORAGE TANK No. 4 (TK-65414)-LEVEL	RIO-5 (PLC-4)	AI	I-03	
LI-65416	BULK STORAGE TANK No. 6 (TK-65416)-LEVEL	RIO-5 (PLC-4)	AI	I-03	
LI-65415	BULK STORAGE TANK No. 5 (TK-65415)-LEVEL	RIO-5 (PLC-4)	AI	I-03	
SI-56616	CL2 CHAMBER REUSE SYST. METERING PUMP NO. 2 (MP-56616)-SPEED FEEDBACK	RIO-5 (PLC-4)	AI	I-04	
SI-56016	CL2 CHAMBER REUSE SYST. METERING PUMP NO. 1 (MP-56016)-SPEED FEEDBACK	RIO-5 (PLC-4)	AI	I-04	
SI-56613A	PRE-CL2 AT FILTERS REUSE SYST. METERING PUMP NO. 2 (MP-56613A)-SPEED FEEDBACK	RIO-5 (PLC-4)	AI	I-04	
SI-56013A	PRE-CL2 AT FILTERS REUSE SYST. METERING PUMP NO. 1 (MP-56013A)-SPEED FEEDBACK	RIO-5 (PLC-4)	AI	I-04	
SI-56612	CL2 CHAMBER NPW SYSTEM METERING PUMP NO. 2 (MP-56612)-SPEED FEEDBACK	RIO-5 (PLC-4)	AI	I-05	
SI-56012	CL2 CHAMBER NPW SYSTEM METERING PUMP NO. 1 (MP-56012)-SPEED FEEDBACK	RIO-5 (PLC-4)	AI	I-05	
SI-56013B	PRE-CL2 AT FILTERS NPW SYST. METERING PUMP NO. 1 (MP-56013B)-SPEED FEEDBACK	RIO-5 (PLC-4)	AI	I-05	
SI-56613B	PRE-CL2 AT FILTERS REUSE SYST. METERING PUMP NO. 2 (MP-56613B)-SPEED FEEDBACK	RIO-5 (PLC-4)	AI	I-05	
SI-56010	HEADWORKS ODOR CONTROL METERING PUMP NO. 1 (MP-56010)-SPEED FEEDBACK	RIO-5 (PLC-4)	AI	I-06	
SI-56610	HEADWORKS ODOR CONTROL METERING PUMP NO. 2 (MP-56610)-SPEED FEEDBACK	RIO-5 (PLC-4)	AI	I-06	
SI-56015	EFFLUENT PUMP STATION METERING PUMP NO. 1 (MP-56015)-SPEED FEEDBACK	RIO-5 (PLC-4)	AI	I-06	
SI-56615	EFFLUENT PUMP STATION METERING PUMP NO. 2 (MP-56615)-SPEED FEEDBACK	RIO-5 (PLC-4)	AI	I-06	
SI-56009	RAS SYSTEM METERING PUMP (MP-56009)-SPEED FEEDBACK	RIO-5 (PLC-4)	AI	I-07	
SI-56011	INFLUENT PUMP STATION METERING PUMP (MP-56011)-SPEED FEEDBACK	RIO-5 (PLC-4)	AI	I-07	
ANALOG OUTPUTS					
SC-56016	CL2 CHAMBER REUSE SYST. METERING PUMP NO. 1 (MP-56016)-SPEED COMMAND	RIO-5 (PLC-4)	AO	I-04	
SC-56616	CL2 CHAMBER REUSE SYST. METERING PUMP NO. 2 (MP-56616)-SPEED COMMAND	RIO-5 (PLC-4)	AO	I-04	
SC-56013A	PRE-CL2 AT FILTERS REUSE SYST. METERING PUMP NO. 1 (MP-56013A)-SPEED COMMAND	RIO-5 (PLC-4)	AO	I-04	
SC-56613A	PRE-CL2 AT FILTERS REUSE SYST. METERING PUMP NO. 2 (MP-56613A)-SPEED COMMAND	RIO-5 (PLC-4)	AO	I-04	
SC-56012	CL2 CHAMBER NPW SYSTEM METERING PUMP NO. 1 (MP-56012)-SPEED COMMAND	RIO-5 (PLC-4)	AO	I-05	

TAG	SERVICE DESCRIPTION	PLC	I/O TYPE	P&ID	NOTES
SC-56612	CL2 CHAMBER NPW SYSTEM METERING PUMP NO. 2 (MP-56612)-SPEED COMMAND	RIO-5 (PLC-4)	AO	I-05	
SC-56013B	PRE-CHLORIN. AT FILTERS NPW SYST. METERING PUMP NO. 1 (MP-56013B)-SPEED COMMAND	RIO-5 (PLC-4)	AO	I-05	
SC-56613B	PRE-CHLORIN. AT FILTERS REUSE SYST. METERING PUMP NO. 2 (MP-56613B)-SPEED COMMAND	RIO-5 (PLC-4)	AO	I-05	
SC-56015	EFFLUENT PS METERING PUMP NO. 1 (MP-56015)-SPEED COMMAND	RIO-5 (PLC-4)	AO	I-06	
SC-56615	EFFLUENT PS METERING PUMP NO. 2 (MP-56615)-SPEED COMMAND	RIO-5 (PLC-4)	AO	I-06	
SC-56010	HEADWORKS ODOR CONTROL METERING PUMP NO. 1 (MP-56010)-SPEED COMMAND	RIO-5 (PLC-4)	AO	I-06	
SC-56610	HEADWORKS ODOR CONTROL METERING PUMP NO. 2 (MP-56610)-SPEED COMMAND	RIO-5 (PLC-4)	AO	I-06	
SC-56009	RAS SYSTEM METERING PUMP (MP-56009)-SPEED COMMAND	RIO-5 (PLC-4)	AO	I-07	
SC-56011	INFLUENT PS METERING PUMP (MP-56011)-SPEED COMMAND	RIO-5 (PLC-4)	AO	I-07	

DISCRETE INPUTS

LAHH-65410-A	CHEMICAL CONTAINMENT-LEVEL ALARM HIGH HIGH	RIO-5 (PLC-4)	DI	I-03	
LAHH-65410-B	CHEMICAL CONTAINMENT-LEVEL ALARM HIGH HIGH	RIO-5 (PLC-4)	DI	I-03	
YA-56016	CL2 CHAMBER REUSE SYST. METERING PUMP NO. 1 (MP-56016)-FAULT	RIO-5 (PLC-4)	DI	I-04	
YA-56616	CL2 CHAMBER REUSE SYST. METERING PUMP NO. 2 (MP-56616)-FAULT	RIO-5 (PLC-4)	DI	I-04	
YL-56616	CL2 CHAMBER REUSE SYST. METERING PUMP NO. 2 (MP-56616)-IN REMOTE	RIO-5 (PLC-4)	DI	I-04	
YL-56016	CL2 CHAMBER REUSE SYST. METERING PUMP NO. 1 (MP-56016)-IN REMOTE	RIO-5 (PLC-4)	DI	I-04	
YA-56613A	PRE-CL2 AT FILTERS REUSE SYST. METERING PUMP NO. 2 (MP-56613A)-FAULT	RIO-5 (PLC-4)	DI	I-04	
YA-56013A	PRE-CL2 AT FILTERS REUSE SYST. METERING PUMP NO. 1 (MP-56013A)-FAULT	RIO-5 (PLC-4)	DI	I-04	
YL-56013A	PRE-CL2 AT FILTERS REUSE SYST. METERING PUMP NO. 1 (MP-56013A)-IN REMOTE	RIO-5 (PLC-4)	DI	I-04	
YL-56613A	PRE-CL2 AT FILTERS REUSE SYST. METERING PUMP NO. 2 (MP-56613A)-IN REMOTE	RIO-5 (PLC-4)	DI	I-04	
YA-56012	CL2 CHAMBER NPW SYST. METERING PUMP NO. 1 (MP-56012)-FAULT	RIO-5 (PLC-4)	DI	I-05	
YA-56612	CL2 CHAMBER NPW SYST. METERING PUMP NO. 2 (MP-56612)-FAULT	RIO-5 (PLC-4)	DI	I-05	
YL-56012	CL2 CHAMBER NPW SYST. METERING PUMP NO. 1 (MP-56012)-IN REMOTE	RIO-5 (PLC-4)	DI	I-05	
YL-56612	CL2 CHAMBER NPW SYST. METERING PUMP NO. 2 (MP-56612)-IN REMOTE	RIO-5 (PLC-4)	DI	I-05	
YA-56013B	PRE-CL2 AT FILTERS NPW SYST. METERING PUMP NO. 1 (MP-56013B)-FAULT	RIO-5 (PLC-4)	DI	I-05	
YA-56613B	PRE-CL2 AT FILTERS NPW SYST. METERING PUMP NO. 2 (MP-56613B)-FAULT	RIO-5 (PLC-4)	DI	I-05	
YL-56013B	PRE-CL2 AT FILTERS NPW SYST. METERING PUMP NO. 1 (MP-56013B)-IN REMOTE	RIO-5 (PLC-4)	DI	I-05	
YL-56613B	PRE-CL2 AT FILTERS NPW SYST. METERING PUMP NO. 2 (MP-56613B)-IN REMOTE	RIO-5 (PLC-4)	DI	I-05	
YA-56010	HEADWORKS ODOR CONTROL METERING PUMP NO. 1 (MP-56010)-FAULT	RIO-5 (PLC-4)	DI	I-06	
YA-56610	HEADWORKS ODOR CONTROL METERING PUMP NO. 2 (MP-56610)-FAULT	RIO-5 (PLC-4)	DI	I-06	

TAG	SERVICE DESCRIPTION	PLC	I/O TYPE	P&ID	NOTES
YL-56010	HEADWORKS ODOR CONTROL METERING PUMP NO. 1 (MP-56010)-IN REMOTE	RIO-5 (PLC-4)	DI	I-06	
YL-56610	HEADWORKS ODOR CONTROL METERING PUMP NO. 2 (MP-56610)-IN REMOTE	RIO-5 (PLC-4)	DI	I-06	
YA-56015	EFFLUENT PUMP STATION METERING PUMP NO. 1 (MP-56015)-FAULT	RIO-5 (PLC-4)	DI	I-06	
YA-56615	EFFLUENT PUMP STATION METERING PUMP NO. 2 (MP-56615)-FAULT	RIO-5 (PLC-4)	DI	I-06	
YL-56015	EFFLUENT PUMP STATION METERING PUMP NO. 1 (MP-56015)-IN REMOTE	RIO-5 (PLC-4)	DI	I-06	
YL-56615	EFFLUENT PUMP STATION METERING PUMP NO. 2 (MP-56615)-IN REMOTE	RIO-5 (PLC-4)	DI	I-06	
YA-56009	RAS SYSTEM METERING PUMP (MP-56009)-FAULT	RIO-5 (PLC-4)	DI	I-07	
YL-56009	RAS SYSTEM METERING PUMP (MP-56009)-IN REMOTE	RIO-5 (PLC-4)	DI	I-07	
YX-56009	RAS SYSTEM METERING PUMP (MP-56009)-READY	RIO-5 (PLC-4)	DI	I-07	
YA-56011	INFLUENT PUMP STATION METERING PUMP (MP-56011)-FAULT	RIO-5 (PLC-4)	DI	I-07	
YL-56011	INFLUENT PUMP STATION METERING PUMP (MP-56011)-IN REMOTE	RIO-5 (PLC-4)	DI	I-07	
YL-56001	CL2 TRANSFER PUMP (TP-56001)-IN REMOTE	RIO-5 (PLC-4)	DI	I-07	
YLR-56001	CL2 TRANSFER PUMP (TP-56001)-RUNNING	RIO-5 (PLC-4)	DI	I-07	
YA-56001	CL2 TRANSFER PUMP (TP-56001)-OVERLOAD FAULT	RIO-5 (PLC-4)	DI	I-07	
FAL-56001	CL2 TRANSFER PUMP (TP-56001)-LOW FLOW ALARM	RIO-5 (PLC-4)	DI	I-07	
FAH-65421	EYE WASH SHOWER NO. 1-HIGH FLOW ALARM	RIO-5 (PLC-4)	DI	I-08	
FAH-65422	EYE WASH SHOWER NO. 2-HIGH FLOW ALARM	RIO-5 (PLC-4)	DI	I-08	
FAH-65423	EYE WASH SHOWER NO. 3-HIGH FLOW ALARM	RIO-5 (PLC-4)	DI	I-08	
FAH-65424	EYE WASH SHOWER NO. 4-HIGH FLOW ALARM	RIO-5 (PLC-4)	DI	I-08	
FAH-65425	EYE WASH SHOWER NO. 5-HIGH FLOW ALARM	RIO-5 (PLC-4)	DI	I-08	
LAH-56016	REMOTE DOSING POINT SUMP NO. 1-HIGH LEVEL ALARM	RIO-5 (PLC-4)	DI	I-08	
LAH-56015	REMOTE DOSING POINT SUMP NO. 2-HIGH LEVEL ALARM	RIO-5 (PLC-4)	DI	I-08	

DISCRETE OUTPUTS

LAH-65411	BULK STORAGE TANK No. 1 (TK-65411)-MAX. FILL LEVEL	RIO-5 (PLC-4)	DO	I-03	
LAH-65412	BULK STORAGE TANK No. 2 (TK-65412)-MAX. FILL LEVEL	RIO-5 (PLC-4)	DO	I-03	
LAH-65413	BULK STORAGE TANK No. 3 (TK-65413)-MAX. FILL LEVEL	RIO-5 (PLC-4)	DO	I-03	
LAH-65414	BULK STORAGE TANK No. 4 (TK-65414)-MAX. FILL LEVEL	RIO-5 (PLC-4)	DO	I-03	
LAH-65415	BULK STORAGE TANK No. 5 (TK-65415)-MAX. FILL LEVEL	RIO-5 (PLC-4)	DO	I-03	
LAH-65416	BULK STORAGE TANK No. 6 (TK-65416)-MAX. FILL LEVEL	RIO-5 (PLC-4)	DO	I-03	
LAHH-65411	BULK STORAGE TANK No. 1 (TK-65411)-HIGH HIGH LEVEL ALARM	RIO-5 (PLC-4)	DO	I-03	

TAG	SERVICE DESCRIPTION	PLC	I/O TYPE	P&ID	NOTES
LAHH-65412	BULK STORAGE TANK No. 2 (TK-65412)-HIGH HIGH LEVEL ALARM	RIO-5 (PLC-4)	DO	I-03	
LAHH-65413	BULK STORAGE TANK No. 3 (TK-65413)-HIGH HIGH LEVEL ALARM	RIO-5 (PLC-4)	DO	I-03	
LAHH-65414	BULK STORAGE TANK No. 4 (TK-65414)-HIGH HIGH LEVEL ALARM	RIO-5 (PLC-4)	DO	I-03	
LAHH-65415	BULK STORAGE TANK No. 5 (TK-65415)-HIGH HIGH LEVEL ALARM	RIO-5 (PLC-4)	DO	I-03	
LAHH-65416	BULK STORAGE TANK No. 6 (TK-65416)-HIGH HIGH LEVEL ALARM	RIO-5 (PLC-4)	DO	I-03	
YCR-56016	CL2 CHAMBER REUSE SYST. METERING PUMP NO. 1 (MP-56016)-RUN CMD	RIO-5 (PLC-4)	DO	I-04	
YCR-56616	CL2 CHAMBER REUSE SYST. METERING PUMP NO. 2 (MP-56616)-RUN CMD	RIO-5 (PLC-4)	DO	I-04	
YCR-56613A	PRE-CL2 AT FILTERS REUSE SYST. METERING PUMP NO. 2 (MP-56613A)-RUN CMD	RIO-5 (PLC-4)	DO	I-04	
YCR-56013A	PRE-CL2 AT FILTERS REUSE SYST. METERING PUMP NO. 1 (MP-56013A)-RUN CMD	RIO-5 (PLC-4)	DO	I-04	
YCR-56012	CL2 CHAMBER NPW SYST METERING PUMP NO. 1 (MP-56012)-RUN CMD	RIO-5 (PLC-4)	DO	I-05	
YCR-56612	CL2 CHAMBER NPW SYST METERING PUMP NO. 2 (MP-56612)-RUN CMD	RIO-5 (PLC-4)	DO	I-05	
YCR-56013B	PRE-CL2 AT FILTERS NPW SYST. METERING PUMP NO. 1 (MP-56013B)-RUN CMD	RIO-5 (PLC-4)	DO	I-05	
YCR-56613B	PRE-CL2 AT FILTERS NPW SYST. METERING PUMP NO. 2 (MP-56613B)-RUN CMD	RIO-5 (PLC-4)	DO	I-05	
YCR-56010	HEADWORKS ODOR CONTROL METERING PUMP NO. 1 (MP-56010)-RUN CMD	RIO-5 (PLC-4)	DO	I-06	
YCR-56610	HEADWORKS ODOR CONTROL METERING PUMP NO. 2 (MP-56610)-RUN CMD	RIO-5 (PLC-4)	DO	I-06	
YCR-56015	EFFLUENT PUMP STATION METERING PUMP NO. 1 (MP-56015)-RUN CMD	RIO-5 (PLC-4)	DO	I-06	
YCR-56615	EFFLUENT PUMP STATION METERING PUMP NO. 2 (MP-56615)-RUN CMD	RIO-5 (PLC-4)	DO	I-06	
YCR-56009	RAS SYSTEM METERING PUMP (MP-56009)-RUN CMD	RIO-5 (PLC-4)	DO	I-07	
YCR-56011	INFLUENT PS METERING PUMP (MP-56011)-RUN CMD	RIO-5 (PLC-4)	DO	I-07	
YCR-56001	TRANSFER PUMP (TP-56001)-START/STOP	RIO-5 (PLC-4)	DO	I-07	
XC-56001	TRANSFER PUMP (TP-56001)-ENABLE LOCAL TRANSFER	RIO-5 (PLC-4)	DO	I-07	

SECTION 40 61 96
PROCESS CONTROL DESCRIPTIONS

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish, test, install and place in satisfactory operation all equipment as herein specified and as shown on the Drawings. THE CONTRACTOR SHALL BE RESPONSIBLE FOR FURNISHING COMPLETE FUNCTIONING SYSTEMS AS DESCRIBED HEREIN.

B. Together with the control system input/output schedule, the equipment specifications (including process control descriptions for local equipment control panels), and the Drawings, the process control descriptions describe the required operation, monitoring, and control of the facilities included in this Contract.

C. THE PROCESS CONTROL DESCRIPTIONS CONTAIN REQUIREMENTS FOR FURNISHING AND INSTALLING LABOR AND MATERIALS THAT MAY NOT APPEAR ELSEWHERE IN THE CONTRACT DOCUMENTS.

D. All equipment and services required in equipment local control panels provided to implement the monitoring and control functions described herein or in the process input/output schedules shall be provided by the Contractor through individual equipment suppliers.

E. Unless specifically stated otherwise, all interconnected wiring between all instruments, panels, controls, and other devices listed in the process control descriptions as required to provide all functions specified herein shall be furnished by the electrical subcontractor under Division 26. The electrical subcontractor shall provide all cable and conduit required to carry all signals listed in the process input/output schedules. Special cables that are required for interconnection between sensors or probes and transmitters or signal conditioners shall be furnished with the instrumentation devices by the equipment supplier.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01 14 00 – Coordination with Owner’s Operations

B. Section 40 61 91 – Process Control System Instrument List

C. Section 40 61 93 – Process Control System Input/Output List

D. Section 46 33 42 – Mechanical Diaphragm Metering Pumps

PART 2 – PROCESS CONTROL DESCRIPTIONS, GENERAL

2.01 DEFINITIONS

A. RUNNING status signals shall be from auxiliary contacts provided with the motor control equipment (i.e., starter, VFD, SCR, etc.).

B. AUTO status signals shall be defined as HAND-OFF-AUTO switch in the AUTO position or process control system in AUTO (versus MANUAL).

C. FAIL status signals shall be defined as motor overload and/or any other shut down mode such as overtorque, overtemperature, low oil pressure, high vibration, etc.

D. READY status signal shall be defined as all conditions, including equipment control power, satisfied to permit remote control of the equipment.

2.02 CONVENTIONS

A. Indicator lights on all MCC's, control panels, starter enclosures, etc. shall conform to the following color convention:

Condition	Color
Running/On/Open	Red
Stopped/Off/Closed	Green
Fault/Alarm	Amber

B. Operator workstation HMI graphic display symbols shall conform to the following color convention:

Condition	Color
Graphic background	Light grey
Running/On/Open	Soft white
Stopped/Off/Closed (in local)	Light grey; black outline (shape)
Stopped/Off/Closed (remote manual)	Blue
Stopped/Off/Closed (remote auto)	Medium grey
Fault/Alarm	Amber
Generic Status	Blue

2.03 PROCESS CONTROL

A. Where setpoints, operating limits, and other control settings are provided by the functional descriptions, these settings shall be initial settings only and shall be used for assistance in the initial startup of the plant. All such settings shall be fully adjustable and, based on actual operating conditions, the instrumentation subcontractor shall make all necessary adjustments to provide smooth, stable operation at no additional cost to the Owner.

B. Provision shall be made in PLC logic to suppress nuisance alarms and control actions by the following means:

1. For analog inputs digital filters shall be used to smooth time varying analog input data in accordance with the equation given below. The filter time constant shall be a function of the sampling period and the digital filtering constant, both of which shall be operator adjustable (password protected).

   The filter calculation shall be executed every 300ms as a starting point. Test and adjust digital filters during commissioning and fine tune as required by the process

2. For alarms and control actions derived from analog input signals, use adjustable time delays and deadbands.

3. For alarms and control actions derived from discrete input signals, use adjustable time delays.

4. Initial settings for time delays shall be 10 seconds (range 0-120 seconds). Initial settings for deadbands shall be 5% of span (range 0-100%).

5. Equipment that is started or stopped manually by the operator shall start or stop immediately, with no time delay.

C. All setpoint control shall be by PID control algorithms. Where only proportional control is specified, tuning constants shall be used to reduce the Integral and Derivative functions to zero. All setpoints, sequence times, sequence orders, dead bands, PID tuning parameters, PLC delay timers, variable speed operating range limits, and similar control constants shall be accessible and alterable from the operator workstations.

D. Unless otherwise specified, all equipment shall automatically restart after a power failure utilizing adjustable start delay timers in PLC control logic. Unless otherwise specified, all PLC control strategies shall be based upon automatic restart after a power failure and shall return to a normal control mode upon restoration of power.

E. The PLC shall be capable of receiving initial run-time values for existing and proposed equipment. Initial run-time shall not automatically be assumed to be zero.

F. A control discrepancy alarm shall be generated through the PLC for any drive, motor, etc. for which a command has been issued, but for which the PLC is not receiving a confirming status signal (e.g., start command with no run feedback). The failure shall be logged.

G. An instrument failure alarm shall be generated for any instrument which is generating a signal that is less than 4 mA or greater than 20 mA.

H. Unless otherwise specified in an individual control description, an instrument failure or control discrepancy alarm shall cause the control strategy to maintain last values and to generate an alarm. Manual initiation of the automatic control strategy shall be required.

I. A control program that controls multiple pieces of equipment shall not be prevented from running because not all of the equipment is in AUTO. If equipment within an equipment chain is required to be running for program operation and it is running in HAND or MANUAL, then the program shall run and control the other equipment that is in AUTO.

J. All PLC wait states (internal time delays, etc.) after an operator action shall be displayed on the operator workstation.

K. When switching from Auto to Manual, controlled equipment shall remain in its current state (e.g., running, stopped, speed, position, etc.). Likewise, when switching from Manual to Automatic, the equipment shall initially be in the current state until the Automatic control strategy requires a change.

PART 3 – PROCESS CONTROL DESCRIPTIONS

3.01 OVERVIEW

A. The Temporary Sodium Hypochlorite System at the City of Hollywood Wastewater Treatment Plant consists of six (6) bulk storage tanks designed to store Sodium Hypochlorite for controlled chemical dosing. The system supplies Sodium Hypochlorite to eight (8) dedicated metering pump skids. Each skid is responsible for delivering a controlled dose of Sodium Hypochlorite to specific injection points within the plant's treatment process.

B. The temporary system is controlled by a newly installed control panel, designated “PLC-4 RIO RACK 5”, equipped a Remote IO (RIO-5) drop connected via fiber to the existing PLC-4 M580. Existing PLC-4 shall manage the dosing control strategy by adjusting dosing rates based on operational requirements and real-time feedback conditions.

C. The control panel communicates with the plant's existing SCADA system via fiber optic communication, enabling real-time monitoring, remote adjustments, and comprehensive performance oversight. Existing SCADA screens will be modified to incorporate the new control and monitoring functions specific to the temporary dosing system.

D. The existing chemical system PLC logic will remain operational until the new system is fully integrated into the SCADA HMI system and declared fully functional.

3.02 SYSTEM AVAILABILITY

A. The Contractor, through the services of the instrumentation and control system subcontractor, shall develop a plan for each phase of the migration from the existing to the new system with respect to the PLC and the SCADA HMI screens development.

B. Fully automatic, continuous operation of the chemical feed systems from the SCADA HMI is required for the duration of the project. Therefore, individual existing chemical systems shall only be taken out of service once the new temporary chemical system has been fully tested and determined to be ready for fully automatic operation from the SCADA HMI.

C. Any exceptions to this requirement must be pre-approved by both the Engineer and City.

3.03 METERING PUMP AUTOMATIC CONTROL STRATEGIES

A. Feed Forward: Ratio Control

The automatic control strategy shall modulate the duty metering pump on each skid to maintain an adjustable ratio setpoint of the chemical (ppm) to the flow to be treated (MGD). The flow required from a feed pump shall be calculated with the following formula:

$$\text{Flow Required (gph)} = \frac{\text{Dosage (ppm)} * \text{Process Flow (MGD)} * 41640(\text{gph/MGD})}{\text{Chemical concentration (ppm)} * \text{Specific Gravity}} \quad (1)$$

Where:

Flow Required: Calculated flow required from the feed metering pump.

Dosage: Amount of chemical in parts per million (ppm) that treated water flow must contain.

Process Flow: Treated water flow, this value depends on the RO skids running or raw water supply.

Chemical Concentration: Specific value for each chemical.

Specific Gravity: Specific value for each chemical.

Example:

Dosage = 2 ppm
Process Flow = 2 MGD
Chemical concentration = 125,000 ppm (12.5%) (assuming specific gravity = 1)
Flow Required = 1.33 gph

If in the example we are using a metering pump with range of 0 – 6.9 gph (linear with speed), the 1.33 gph flow required equates to a speed of 19.28%.

B. Feedback Control

Feedback involves measuring the output of a process and comparing it to a desired setpoint. The feedback PID controller shall maintain a constant residual at a pre-set value (operator setpoint). The feedback PID controller output shall adjust the setpoint of the ratio controller which combines the feedforward and feedback loops. There shall be two selectable options for trim feedback.

1. Trim Mode 1: Fixed incremental trim value, initially set at ± 0.1 ppm. Repeat after an adjustable set duration, initially set at 2 minutes.

   Example:

   In remote automatic mode, the duty pump output will be modulated to maintain a ratio of Sodium Hypochlorite to the flow at the Effluent Pump Station Wetwell. With chlorine residual feedback trim enabled and set to “Trim Mode 1 - Fixed”, the chlorine analyzer feedback indicates that the chlorine residual at the effluent is 0.60 ppm, which is below the 0.80 ppm set-point and outside of an adjustable ±0.05 ppm deadband. The Sodium Hypochlorite ratio target set-point shall be incrementally

increased 0.1 ppm every 2 minutes until the chlorine residual feedback indicates that the value is between 0.75 ppm and 0.85 ppm.

2. Trim Mode 2: The proportional trim value will increase or decrease the ratio setpoint on the magnitude of difference between the target setpoint and the measured value, the resulting calculation is also referred to as the error “e”. Proportional trim shall function in the same manner as the Trim Mode 1 example above, except the increment value shall be proportional to the error times the gain. The amount of change in the target chemical setpoint output shall be determined by the following equation:

$$\Delta \mathrm{SP} = \mathrm{G} * (\mathrm{SP} - \mathrm{PV}) = \mathrm{G} * \mathrm{e}$$

Where:

$\Delta \mathrm{PS}$: Change target setpoint output required.

G: Gain (operator adjustable).

SP: Setpoint (Operator adjustable).

PV: Process Variable.

e: Error.

Example:

In remote automatic mode, the duty pump output will be modulated to maintain a ratio of Sodium Hypochlorite to the flow at the Effluent Pump Station Wetwell. With chlorine residual feedback trim enabled and set to “Trim Mode 2 – Proportional” and a target chlorine residual of 2.5 ppm, starting with a ratio setpoint of 3 ppm, the feedback indicates a chlorine residual of 2.0 ppm, which is outside the ±0.1 ppm deadband.

The error is:

e = SP - PV = 2.5 – 2.0 = +0.50

With the gain “G” set at 0.3, the proportional response is:

ΔSP = 0.3 x 0.50 = +0.15

The +0.15 ΔSP is applied to the ratio setpoint, 3.0 + 0.15 = 3.15 ppm, resulting in a new ratio setpoint of 3.15 ppm. The logic will execute again after an operator’s adjustable time delay initially set at 2 minutes. During the next iteration, the error is determined to be +0.30 ppm which is outside the deadband, so the trim is applied:

ΔSP = 0.3 x 0.3 = +0.09

The +0.09 ΔSP is applied to the ratio setpoint, 3.15 + 0.09 = 3.24 ppm, resulting in a new ratio setpoint of 3.24 ppm. After 2 minutes the logic is executed again, and the error is determined to be +0.05 ppm which is inside the deadband, so no action is taken for 2 minutes.

In general, the ratio value shall be limited to minimize overfeed or underfeed in the event of chlorine analyzer malfunction. In addition, the operator shall have the option of disabling the trim modes mentioned above to limit the control output to ratio control only.

3.04 CONTROL STRATEGIES INDEX

Section	Description
3.05	Sodium Hypochlorite Storage System
3.06	Sodium Hypochlorite Transfer System
3.07	Sodium Hypochlorite Feed System

3.05 SODIUM HYPOCHLORITE STORAGE SYSTEM

Drawings: I-03

A. Process Overview

1. The system consists of six (6) bulk storage tanks within a dedicated chemical containment area, designed to store Sodium Hypochlorite before dosing to the injection points throughout the plant.

2. Bulk storage tanks TK-65411, TK-65413 and TK-65415 are controlled by the East Sodium Hypochlorite Unloading Local Alarm Panel (LAP-65421). Bulk storage tanks TK-65412, TK-65414 and TK-65416 are controlled by the West Sodium Hypochlorite Unloading Local Alarm Panel (LAP-65422). The control panels transmit signals via hardwired cables to the “PLC-4 RIO RACK 5” control panel, which is equipped with RIO-5, an Ethernet Remote I/O drop connected to the existing PLC-4. PLC-4 communicates with the plant's SCADA system enabling real-time monitoring and control of the Sodium Hypochlorite dosing system from the central SCADA interface.

3. Leak sensors, LSH-65410-A and LSH-65410-B, are installed in two sumps within the containment area to monitor chemical leaks. If a leak is detected, an alarm will be triggered and sent to the SCADA system via the Sodium Hypochlorite Containment Alarm Panel CAP-65410.

B. Control Operation

1. Each bulk storage tank is equipped with a reverse float sight gauge to indicate level and a radar sensor level transmitter. The level transmitter provides analog output to the Unloading Local Alarm Panel for indication of level, via an electronic indicator, as specified in Section 40 78 00 – Panel Mounted Instruments, that receives and displays the 4-20mA radar level signal. The panel is also equipped with pilot lights to indicate maximum fill level and high-high level alarm.

    a. Maximum fill level shall be a relay output, received by the Unloading Local Alarm Panel, from PLC-4 that is setpoint adjustable from SCADA. When maximum fill level condition is reached, control logic in the panel shall energize a panel mounted horn. Once the “reset” pushbutton has been pressed the horn shall deactivate.

    b. High-high level alarm shall be a relay output, received by the Unloading Local Alarm Panel, from PLC-4 that is setpoint adjustable from SCADA. High-high level setpoint shall be set above the maximum fill level setpoint. When high-high level condition is reached, control logic in the panel shall energize a panel mounted horn. Once the “reset” pushbutton has been pressed the horn shall deactivate. The pilot light shall remain

2. A sliding type float level switches, LSH-65410-A & LSH-65410-B, provides discrete output to the Sodium Hypochlorite Containment Alarm Panel, LAP-65410, when sump high level is detected in the chemical containment area. If the level switch detects a high level condition, control logic in the panel shall energize a panel-mounted horn and strobe local alarm and send alarm signals to SCADA. Once the high level condition is no longer present and the “reset” pushbutton has been pressed the horn and flashing light shall deactivate and alarm shall be reset. If the high level condition is still active and the “reset” pushbutton is pressed, the horn shall deactivate, the flashing light shall remain active and alarm shall remain latched.

C. Bulk Storage Tank Enable/Disable Feature

1. The SCADA system shall provide a screen-based functionality to enable or disable each individual bulk storage tank. This enable/disable status shall be configurable via the SCADA HMI and shall define which tanks are active for control strategy purposes.

2. Low level and high-high level alarm evaluation by PLC-4 shall only consider bulk tanks currently enabled through SCADA.

3. Storage tank enable/disable status shall be clearly indicated on the SCADA HMI.

D. Bulk Storage Tank Drain Rate Monitoring

1. PLC-4 shall continuously monitor the chemical drain rate in the bulk tanks installed under this contract via radar level transmitters. The PLC logic utilizes rate-of-change

(derivative) type calculations for determining the drain rate of each tank and compare the calculated rate with SCADA adjustable alarm set-points.

2. There shall be two configurable drain rate set-points for each chemical bulk storage tank: one for when no metering pumps are operating (static condition), and one for when one or more metering pumps are actively dosing (dynamic condition). The PLC logic shall automatically apply the appropriate set-point based on the operating status of the metering pumps. A critical alarm popup shall be displayed on the SCADA HMI if the measured drain rate exceeds the active set-point for more than 15 seconds: “Bulk Storage Tank High Drain Rate!”.

3. The drain rate alarm logic shall be disabled for any tank currently involved in a transfer operation (i.e., being drained into another tank), as such tank shall be marked as disabled in the system during the transfer.

4. Tank drain rate set-point values shall be coordinated with Engineer prior to the chemical feed system startup period during the independent radar testing sequence. The alarms shall be tested by filling and emptying bulk tanks with water to simulate a leak and shall be witnessed by Engineer.

3.06 SODIUM HYPOCHLORITE TRANSFER SYSTEM

Drawings: I-07 and I-11

A. Process Overview

1. The transfer system allows for the transfer of sodium hypochlorite from one bulk storage tank to another via the transfer pump TP-56001. The transfer process is manually configured by plant operators using the installed manual isolation valves. Before initiating a transfer, operators must manually select the source and destination tanks by positioning the appropriate isolation valves.

2. The system includes a dedicated Sodium Hypochlorite Transfer Local Control Panel LCP-56001, which provides status indication and control for the transfer pump.

B. Control Operation

1. Local controls

When the Hand-Off-Remote (HOR) selector switch, located in LCP-56001, is in the “Hand” position, a local call-to-run request for the transfer pump is issued. If an operator intends to initiate a local transfer using LCP-56001 in "Hand" mode, operations shall first notify SCADA to request authorization. SCADA shall issue an enable signal, implemented as a discrete output from PLC-4 to LCP-56001. The transfer pump shall only operate in "Hand" mode if this enable signal is received. If the enable signal is not received, the pump shall remain off even if the selector

switch is placed in the "Hand" position. When the selector switch is in the “Off” position, the transfer pump shall stop.

2. Remote Controls

When the Hand-Off-Remote selector switch, located in LCP-56001, is in “Remote” position, the transfer pump shall be controlled by PLC-4 logic. The operator shall be able to start/stop the pump via the SCADA screen. However, issuing a start command from SCADA shall not cause the pump to operate until the PLC generates the enable signal based on proper tank selection.

3. Common Enable Logic for Local and Remote Start Requests

Regardless of whether the start request originates from local mode (via HOR switch in “Hand”) or from remote mode (via SCADA system), the PLC shall issue an enable signal prior to allowing the pump to operate. A new dedicated SCADA screen shall be provided to allow the operator to select the source tank(s) and destination tank(s) involved in the transfer. Based on this selection, the PLC shall evaluate level conditions in the specified tanks. Once tank selections are made, the operator shall press the “*Enable Transfer*” button on the SCADA screen. This action will cause the PLC to activate a discrete digital output, issuing the enable signal required to permit pump operation. After the pump stops, the enable signal shall reset automatically, requiring the operator to re-select tanks and re-enable the transfer for each new pump transfer cycle.

4. Software Interlocks

The PLC shall continuously monitor stop conditions based on the selected tanks, including:

a. Maximum fill level or high-high level alarm in any of the destination tanks.

b. Low-low level alarm in any of the source tanks.

c. Flow not detected by low flow switch FSL-56001 while the pump is running.

3.07 SODIUM HYPOCHLORITE FEED SYSTEM

Drawings: I-04, I-05, I-06 and I-07.

A. Process Overview

1. The Sodium Hypochlorite Feed System consists of eight (8) metering pump skids. Each metering pump skid is controlled by a dedicated local control panel. The local control panels transmit control signals via hardwired connections to the temporary system control panel PLC-4 RIO RACK 5. Each skid is responsible for delivering a controlled dose of Sodium Hypochlorite to specific injection points throughout the

plant. The table 3.07A summarizes the injection points, configuration type, and reference drawing for each skid:

Table 3.07A – Sodium Hypochlorite Feed Systems

Injection Point	Configuration	Control panel	Drawing
Chlorine Contact Chamber Reuse system	Duplex	LCP-56016	I-04
Pre-chlorination at Filters Reuse system	Duplex	LCP-56013A	I-04
Chlorine Contact Chamber Non-potable water system	Duplex	LCP-56012	I-05
Pre-chlorination at Filters Non-potable water system	Duplex	LCP-56013B	I-05
Headworks Odor Control System	Duplex	LCP-56010	I-06
Effluent Pump Station	Duplex	LCP-56615	I-06
RAS Pump Station	Simplex	LCP-56009	I-07
Influent Pump station	Simplex	LCP-56011	I-07

B. Control Operations

1. Local Controls

Each metering pump skid is equipped with a dedicated local control panel as listed in Table 3.07A, that allows for independent operation and monitoring. When a pump's Local-Off-Remote selector switch is set to "Local" position, the pump speed shall be controlled locally by the operator from the control panel keypad.

For the Effluent Pump Station metering pump skid, a Local Control Station (LCS-56615) shall be provided by the metering pump skid manufacturer and installed near the dosing point. The LCS shall be equipped with two (2) Local-Off-Remote (LOR) switches, one for each pump, to enable local operation. Refer to Drawing I-06.

2. Remote Manual Controls

When a pump's Local-Off-Remote selector switch is set to "Remote" position, the pump speed shall be controlled by PLC-4. The operator shall be able to select automatic or manual mode on the SCADA screen. The transition between automatic and manual mode shall be bumpless. In manual mode, the operator is to start, stop and control the speed of the pump from the SCADA screen. This remote manual operation applies to all eight (8) dosification systems with the following exception:

Headworks Odor Control system – Special Manual Mode

In addition to standard Remote Manual control, the Headworks Odor Control System shall also provide four (4) predefined dosing rate modes. These preset modes shall be selectable by the operator via the SCADA HMI and shall define specific dosing speeds as shown in Table 3.07B. These preset dosing rates shall be the default mode, as no H_2S or ORP feedback control is included in the current system design.

Table 3.07B – Preset Dosing Rates

Dosing rate	Flow	Expected H_2S Concentration
Low	9 gph	5 ppmv
Medium	18 gph	10 ppmv
High	45 gph	25 ppmv
Max.	90 gph	50 ppmv

3. Remote Auto Controls

In auto mode, each metering pump skid operates under an automatic control strategy based on the specific requirements of each injection point. The control strategy is managed by the PLC-4 logic.

a. Chlorine Contact Chamber – Reuse system

Ratio Control

The feed automatic control logic shall calculate the flow required to maintain a ratio of sodium hypochlorite to reuse water flow by using equation (1) in Section 3.03 above. The calculated “flow required” value shall be used by the PLC logic to modulate the duty metering pump speed to maintain a setpoint adjustable ratio. The “flow required” value shall be calculated based on:

1) Dosage: Amount of sodium hypochlorite in ppm (parts per million) required to treat the reuse water flow. This value shall be coordinated with the Owner and the Engineer during startup.

2) Process Flow: Total reuse water flow (MGD).

3) Chemical concentration: The concentration (ppm) of the sodium hypochlorite solution being used.

4) Specific gravity: The specific gravity of the Sodium Hypochlorite solution.

Feedback Control

PLC automatic control strategy shall incorporate a sodium hypochlorite trim to enhance the flow rate control. It shall be possible to enable/disable this feature from the SCADA. The trim logic will only execute if the ratio setpoint falls

outside of an adjustable deadband and shall be executed based on a SCADA adjustable duration that continuously repeats. There shall be two selectable options for sodium hypochlorite trim that were explained in Section 3.03-B above. PLC logic shall use the influent chlorine residual signal from the low saline chlorine contact chamber to trim the dosing setpoint.

Software Interlocks

PLC logic shall prevent the metering pump from starting if any of the following conditions are met. This applies to both remote manual and remote automatic modes.

1) All bulk storage tanks currently enabled via SCADA are simultaneously in low level alarm condition.

2) Reuse water flow signal lost or out of range.

3) Influent chlorine residual signal lost or out of range.

b. Pre-chlorination at Filters – Reuse system

Ratio Control

The feed automatic control logic shall calculate the flow required to maintain a ratio of sodium hypochlorite to flow from low saline filter feed pumps by using equation (1) in Section 3.03 above. The calculated “flow required” value shall be used by the PLC logic to modulate the duty metering pump speed to maintain a setpoint adjustable ratio. The “flow required” value shall be calculated based on:

1) Dosage: Amount of sodium hypochlorite in ppm (parts per million) required to treat the flow from low saline filter feed pumps. This value shall be coordinated with the Owner and the Engineer during startup.

2) Process Flow: Flow from low saline filter feed pumps (MGD).

3) Chemical concentration: The concentration (ppm) of the sodium hypochlorite solution being used.

4) Specific gravity: The specific gravity of the Sodium Hypochlorite solution.

Software Interlocks

PLC logic shall prevent the metering pump from starting if any of the following conditions are met. This applies to both remote manual and remote automatic mode.

1) All bulk storage tanks currently enabled via SCADA are simultaneously in low level alarm condition.

2) Flow from low saline filter feed pumps signal lost or out of range.

c. Chlorine Contact Chamber – Non-potable water system

Ratio Control

The feed automatic control logic shall calculate the flow required to maintain a ratio of sodium hypochlorite to non-potable water (NPW) flow by using equation (1) in Section 3.03 above. The calculated “flow required” value shall be used by the PLC logic to modulate the duty metering pump speed to maintain a setpoint adjustable ratio. The “flow required” value shall be calculated based on:

1) Dosage: Amount of sodium hypochlorite in ppm (parts per million) required to treat the NPW flow. This value shall be coordinated with the Owner and the Engineer during startup.

2) Process Flow: Total NPW flow (MGD).

3) Chemical concentration: The concentration (ppm) of the sodium hypochlorite solution being used.

4) Specific gravity: The specific gravity of the Sodium Hypochlorite solution.

Feedback Control

PLC automatic control strategy shall incorporate a sodium hypochlorite trim to enhance the flow rate control. It shall be possible to enable/disable this feature from the SCADA. The trim logic will only execute if the ratio setpoint falls outside of an adjustable deadband and shall be executed based on a SCADA adjustable duration that continuously repeats. There shall be two selectable options for sodium hypochlorite trim that were explained in Section 3.03-B above. PLC logic shall use the influent chlorine residual signal from the saline chlorine contact chamber to trim the dosing setpoint.

Software Interlocks

PLC logic shall prevent the metering pump from starting if any of the following conditions are met. This applies to both remote manual and remote automatic mode.

1) All bulk storage tanks currently enabled via SCADA are simultaneously in low level alarm condition.

2) NPW flow signal lost or out of range.

3) Influent chlorine residual signal lost or out of range.

d. Pre-chlorination at Filters – Non-potable water system

Ratio Control

The feed automatic control logic shall calculate the flow required to maintain a ratio of sodium hypochlorite to flow from saline filter feed pumps by using equation (1) in Section 3.03 above. The calculated “flow required” value shall be used by the PLC logic to modulate the duty metering pump speed to maintain a setpoint adjustable ratio. The “flow required” value shall be calculated based on:

1) Dosage: Amount of sodium hypochlorite in ppm (parts per million) required to treat the flow from saline filter feed pumps. This value shall be coordinated with the Owner and the Engineer during startup.

2) Process Flow: Flow from saline filter feed pumps (MGD).

3) Chemical concentration: The concentration (ppm) of the sodium hypochlorite solution being used.

4) Specific gravity: The specific gravity of the sodium hypochlorite solution.

Software Interlocks

PLC logic shall prevent the metering pump from starting if any of the following conditions are met. This applies to both remote manual and remote automatic mode.

1) All bulk storage tanks currently enabled via SCADA are simultaneously in low level alarm condition.

2) Flow from saline filter feed pumps signal lost or out of range.

e. Headworks Odor Control system

Feedback Control Mode

If an H_2S or ORP sensor is provided by others and a 4-20 mA signal becomes available via SCADA, the PLC shall allow automatic control of the sodium hypochlorite dosing pump based on that analog signal. A selection switch shall be provided in the SCADA HMI to allow the operator to enable or disable this mode.

A PID control loop, managed by PLC-4, shall maintain an operator defined H_2S or ORP setpoint received from SCADA. The PID control loop shall continuously adjust chemical dosing to maintain the operator-defined setpoint.

Software Interlocks

PLC logic shall prevent the metering pump from starting if any of the following conditions are met. This applies to both remote manual and remote automatic mode.

1) All bulk storage tanks currently enabled via SCADA are simultaneously in low level alarm condition.

2) Loss of signal or out-of-range condition from the H_2S or ORP sensor, if Feedback Control Mode is selected.

3) No running status signal received from any recirculation pump associated with the scrubber system.

4) No running status signal received from any fan associated with the scrubber system.

f. Effluent Pump Station

Ratio Control

The feed automatic control logic shall calculate the flow required to maintain a ratio of sodium hypochlorite to total effluent flow by using equation (1) in Section 3.03 above. The calculated “flow required” value shall be used by the PLC logic to modulate the duty metering pump speed to maintain a setpoint adjustable ratio. The “flow required” value shall be calculated based on:

1) Dosage: Amount of sodium hypochlorite in ppm (parts per million) required to treat the effluent flow. This value shall be coordinated with the Owner and the Engineer during startup.

2) Process Flow: The total effluent flow (in MGD), which provides the feedforward basis for the ratio control.

3) Chemical concentration: The concentration (ppm) of the Sodium Hypochlorite solution being used.

4) Specific gravity: The specific gravity of the Sodium Hypochlorite solution.

Feedback Control

PLC automatic control strategy shall incorporate a sodium hypochlorite trim to enhance the flow rate control. It shall be possible to enable/disable this feature from the SCADA. The trim logic will only execute if the ratio setpoint falls outside of an adjustable deadband and shall be executed based on a SCADA adjustable duration that continuously repeats. There shall be two selectable options for sodium hypochlorite trim that were explained in Section 3.03-B above. PLC logic shall use the effluent chlorine residual signal to trim the dosing setpoint.

Software Interlocks

PLC logic shall prevent the metering pump from starting if any of the following conditions are met. This applies to both remote manual and remote automatic mode.

1) All bulk storage tanks currently enabled via SCADA are simultaneously in low level alarm condition.

2) Effluent flow signal lost or out of range.

3) Chlorine residual signal lost or out of range.

g. RAS Pump Station

Ratio Control

The feed automatic control logic shall calculate the flow required to maintain a ratio of sodium hypochlorite to total RAS flow by using equation (1) in Section 3.03 above. The calculated “flow required” value shall be used by the PLC logic to modulate the duty metering pump speed to maintain a setpoint adjustable ratio. The “flow required” value shall be calculated based on:

1) Dosage: Amount of sodium hypochlorite in ppm (parts per million) required to treat the total RAS flow. This value shall be coordinated with the Owner and the Engineer during startup.

2) Process Flow: The total RAS flow (in MGD), which provides the feedforward basis for the ratio control.

3) Chemical concentration: The concentration (ppm) of the Sodium Hypochlorite solution being used.

4) Specific gravity: The specific gravity of the Sodium Hypochlorite solution.

Software Interlocks

PLC logic shall prevent the metering pump from starting if any of the following conditions are met. This applies to both remote manual and remote automatic mode.

1) All bulk storage tanks currently enabled via SCADA are simultaneously in low level alarm condition.

2) Total RAS flow signal lost or out of range.

h. Influent Pump station

Ratio Control

The feed automatic control logic shall calculate the flow required to maintain a ratio of sodium hypochlorite to total influent flow by using equation (1) in Section 3.03 above. The calculated “flow required” value shall be used by the PLC logic to modulate the duty metering pump speed to maintain a setpoint adjustable ratio. The “flow required” value shall be calculated based on:

1) Dosage: Amount of sodium hypochlorite in ppm (parts per million) required to treat the influent flow. This value shall be coordinated with the Owner and the Engineer during startup.

2) Process Flow: The total influent flow (in MGD), which provides the feedforward basis for the ratio control.

3) Chemical concentration: The concentration (ppm) of the Sodium Hypochlorite solution being used.

4) Specific gravity: The specific gravity of the Sodium Hypochlorite solution.

Software Interlocks

PLC logic shall prevent the metering pump from starting if any of the following conditions are met. This applies to both remote manual and remote automatic mode.

1) All bulk storage tanks currently enabled via SCADA are simultaneously in low level alarm condition.

2) Total influent flow signal lost or out of range.

3.08 ADDITIONAL PLC AND SCADA HMI PROGRAMMING

A. In addition to the SCADA graphics screens modifications and additions described in this Division and indicated on the Drawings, the Contractor, through the instrumentation and controls subcontractor, shall furnish and install up to two (3) new SCADA HMI graphic screens, ten (10) unique SCADA pop-up notifications, and five (5) unique SCADA equipment faceplates at the request of the Engineer at no additional cost to the City.

B. In addition to the PLC functions described in this Section and indicated on the Drawings, the Contractor, through the instrumentation and controls subcontractor, shall furnish and install up to ten (10) additional Ethernet network-based interlocks and up to ten (10) additional monitoring/control functions between existing PLC-4 and any other PLC, which is considered necessary to provide a fully functional control system based on the opinion of the Engineer at no additional cost to the City.

END OF SECTION

SECTION 40 62 00
COMPUTER SYSTEM HARDWARE AND ANCILLARIES

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The process control system is physically and functionally distributed between PLC equipped control panels, motor control panels, field panels, operator workstations and appurtenances.

B. Although manual control facilities shall be provided adjacent to each final control element or in local control panels, such facilities are for testing, maintenance and local monitoring purposes only and shall not be regarded as backup to the PLC-based control system.

C. PLCs may be categorized as either “process PLCs” or “integration PLCs” that are provided by the instrumentation subcontractor or “equipment control PLCs” or “vendor PLCs” or “packaged PLCs” provided by equipment manufacturers for the operation of their equipment (e.g., RO membranes, chemical systems). Unless otherwise specified, all PLCs provided under this Contract shall conform to the requirements specified in this Division.

D. Major plant control system digital equipment items are described in the Specifications and shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 40 63 43 – Programmable Logic Controllers

B. Section 40 66 00 – Network and Communication Equipment

1.03 DIGITAL HARDWARE CONFIGURATIONS

A. The digital hardware configuration shown on the Control System Architecture Drawing depicts overall system configuration requirements. System design shall be based upon this concept and shall provide an overall digital system availability of 99.8 percent under the conditions specified in Section 40 61 21.73 – Final Acceptance Test. Unless otherwise specified, designs that vary from this concept will be rejected.

B. All discrete and analog data acquisition, pre-processing, storage and process control functions shall be performed at the PLC level. Run time and flow accumulations shall be performed at the PLC level. Except for minimal calculations related to report-specific functions such as minimum, maximum, average, etc., operator workstations shall not be used to perform calculation for the process control system. Operator workstations shall be fully independent devices, individually connected to the plant control system networks.

PART 2 – PRODUCTS

2.01 GENERAL SYSTEM HARDWARE REQUIREMENTS

A. Unless otherwise specified, all hardware shall be rated for industrial use, resistant to shock, vibration, electromagnetic interference, static discharge, and suitable for the environmental conditions described elsewhere in this Division. Commercial or office grade equipment shall not be accepted.

B. Unless otherwise specified, modular construction shall be employed to simplify maintenance and to provide for future hardware expansion. Plug-in, modular PCB's or modules shall be employed for easy removal to permit exposure of circuit wiring, components and test points. Extender boards shall be provided, if necessary, to permit PCB's to be completely exposed for testing purposes.

C. Keying schemes shall be used to prevent PCB misplacement.

D. The temperature inside each enclosure containing digital hardware (i.e., cabinet, panel or console) shall be continuously monitored and shall generate an alarm to the nearest PLC if the temperature rises to an adjustable, preset high temperature.

2.02 DIGITAL SYSTEM FAILURE DETECTION AND FAIL-OVER REQUIREMENTS

A. No degradation in control system performance shall occur when the system is operating in a partial failure or an equipment fail-over mode. Likewise, no degradation of system performance shall occur while a backed up system component is undergoing preventive or corrective maintenance.

B. All devices connected to the plant control system network shall be self-checking and shall report their operational status to the operator workstations as either "normal" or "failed". A graphic display based on the system architecture drawing shall be furnished with the control and information system showing this information along with current communication status of each device.

PART 3 – EXECUTION

3.01 REQUIREMENTS

A. Refer to Section 40 61 13 – Process Control System General Provisions.

END OF SECTION

SECTION 40 63 43
PROGRAMMABLE LOGIC CONTROLLERS (PLC)

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish, test, install and place in satisfactory operation all Remote I/O (RIO) systems, including full integration with existing PLCs. The scope includes providing all spare parts, accessories, and appurtenances as herein specified and as shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 40 61 13 – Process Control System General Provisions

B. Section 40 61 23 – Signal Coordination Requirements

C. Section 40 62 00 – Control and Information System Hardware - General

D. Section 40 66 00 – Network and Communication Equipment

E. Section 40 67 63 – Uninterruptible Power Systems

F. Section 40 67 00 – Control System Equipment Panels and Racks

1.03 TOOLS, SUPPLIES AND SPARE PARTS

A. Tools, supplies and spare parts shall be provided as specified in Section 40 61 22 – Tools, Supplies, and Spare Parts. In addition, the following specific spare parts items shall be provided:

1. One (1) of each type of remote I/O adapter, fiber optic repeater and power supply module furnished under this Contract.

2. One (1) of each type of Input/Output module and equipment power supply furnished under this Contract.

PART 2 – PRODUCTS

2.01 COMMUNICATIONS

A. Remote I/O (RIO) communications shall be provided as specified in Section 40 66 00 – Network and Communication Equipment and as shown on the Network Block Diagram (I-02).

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B. In addition to a communications port for the control system network, communication ports shall be provided for any other devices required (i.e., operator interface unit) plus an additional communication port for connection to a notebook computer.

C. The Remote I/O adapter shall support Ethernet-based communication compatible with the Modicon M580 architecture, including Modbus TCP or native RIO protocols, ensuring seamless integration with the existing PLC-4 (M580). The Contractor shall coordinate the efforts of the necessary parties (instrumentation subcontractor and equipment suppliers) to configure addressing and data mapping between the existing PLC and the new RIO drop.

D. Additional communication modules or protocol gateways may be required to support specific communication protocols required under this Contract and shall be supplied at no extra cost to the Owner.

2.02 INPUT/OUTPUT SUBSYSTEMS

A. Input/output hardware shall be plug-in modules compatible with the Modicon X80 Remote I/O backplane/chassis. Each RIO adapter module unit shall handle the required number of process inputs and outputs plus a minimum of 10 percent active pre-wired spares for each I/O type furnished, plus a minimum of 20 percent spare I/O module space for the addition of future circuit cards or modules.

B. Discrete inputs shall be 24 VDC or 120 VAC signals from dry field contacts. Discrete outputs shall be 24 VDC or 120 VAC outputs or dry relay contacts (2A minimum) as required. Refer to Section 40 61 23 – Signal Coordination Requirements for further details of discrete signal type and voltage requirements. Interposing relays shall be provided where required to interface with field equipment. Interposing relays shall be as specified in Section 40 78 00 – Panel Mounted Instruments. Electrical isolation shall be provided where required. Maximum density for discrete I/O modules shall be 32 per input module and 16 per output module.

C. Analog input circuits shall be isolated, minimum 16-bit resolution type. In general, analog input modules shall be capable of receiving 4-20 mA signals. Where required, RTD input modules shall have a minimum resolution of 0.15°C and be capable of accepting signals from 100-ohm Platinum RTDs. Analog outputs shall be isolated 24 VDC 4-20 mA outputs. Each input/output circuit shall have optical isolation to protect the equipment against high voltage transients. Optical isolation shall be rated at not less than 1500 V RMS. Lightning/surge protection shall be provided as specified in Section 40 78 56 – Isolators, Intrinsically-Safe Barriers, and Surge Suppressors. Maximum density for analog I/O modules shall be 8 per module.

D. Input/output modules shall be configured for ease of wiring and maintenance. The modules shall be connected to wiring arms that can be disconnected to permit removal of a module without disturbing field wiring. Covers shall be provided to prevent operator personnel from inadvertently touching the terminals. The process interface modules shall

be provided with screw-type terminal blocks with barriers between adjacent terminals for connection of field inputs. Terminals shall be suitable for accepting up to and including No. 14 AWG wire. All DC output circuits to the field shall include fuses, either integral or at the terminal strip. Output failure mode shall be selectable so that upon station or communication system failure all outputs shall be placed either in the non-conducting mode or remain as were prior to failure. Light-emitting diodes shall be provided for status indication for each input and output point.

E. External power supplies shall be provided for the Remote I/O system as required to meet specified installed I/O power requirements plus spares. Power supplies shall be modular units, shall be fully redundant and shall alarm the existing PLC upon failure. Power supplies shall have a line regulation of 0.05% and meet the environmental and power requirements specified herein.

2.03 REMOTE I/O SUBSYSTEMS

A. Remote I/O shall be provided as designated on the Network Block Diagram drawing I-02. Remote I/O shall be PLC backplane type I/O or field modules as manufactured by the PLC manufacturer. Field modules shall meet the requirements of Subsection 2.02, Input/Output Subsystems. Remote I/O processor or communication modules shall be modular and individually replaceable.

B. The existing PLC-4 (M580) rack shall be modified, only if necessary, to ensure proper communication with the new RIO-5 system. Modifications shall be made in accordance with this specification and as shown on the Instrumentation Drawings.

C. Remote I/O adapter modules shall be modular, individually replaceable and shall support Ethernet communications across the remote backplane. All modules shall be fully compatible with the existing Modicon M580 PLC platform and conform to Schneider electric's X80 hardware series specifications. Remote I/O shall consist, as a minimum, of the following modules:

1. BMXCPS2010: X80 DC Power Supply Module, 24 VDC, 17W, isolated.

2. BMXCRA31210: Performance Ethernet Drop adapter.

3. BMXNRP0201: Fiber Optic repeater, single mode, 2 RJ45 ethernet ports, 2 optical ports with SFP transceiver for LC-type connector.

2.04 INPUT/OUTPUT CIRCUIT ARRANGEMENT

A. Signal and control circuitry to individual input/output boards shall be arranged such that board failure shall not disable more than one half of the control loops within any group of controlled equipment (e.g., one pump out of a group of three pumps, two pumps out of four, etc.). Where possible, individual control loops and equipment shall be assigned to individual boards such that failure of the board will disable only one loop or piece of equipment.

PART 3 – EXECUTION

3.01 REQUIREMENTS

A. Existing PLC-4 programming modifications shall be done to perform all functions described in Section 40 61 96 – Process Control Descriptions, including global functions. In addition, existing PLC-4 shall be programmed to provide additional functions described in other Sections of this Division.

B. Extensive comments shall be placed in the program code to describe the functions of all elements of the program code. PLC code that does not contain comments shall be rejected.

C. Refer to Section 40 61 13 – Process Control System General Provisions, Part 3 for additional requirements.

END OF SECTION

SECTION 40 66 00
NETWORK AND COMMUNICATION EQUIPMENT

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish, test, install and place in satisfactory operation IEEE 802.3 ethernet local area network(s) for communications among plant devices.

B. Local area network shall be provided with all spare parts, accessories, and appurtenances as herein specified.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 40 61 13 – Process Control System General Provisions

B. Section 40 63 43 – Programmable Logic Controllers

1.03 TOOLS, SUPPLIES AND SPARE PARTS

A. The following specific spare parts items shall be provided:

1. A termination tool kit shall be provided containing all required tools and consumables for up to 25 connections of each connection type furnished. Termination kit shall be as manufactured by Black Box, Corning Cable Systems, Optical Cable Corporation, or equal.

2. One (1) spare industrial ethernet switch of the same make and model furnished for “PLC-4 RIO RACK 5” control panel.

3. Two (2) spare patch cables of each type and of the maximum length used.

4. Two (2) spare GBIC or SFP modules for each type used.

5. One (1) spare media converter for each type used.

1.04 SUBMITTALS

1. Fiber optic testing results, including signal attenuation for each fiber

PART 2 – PRODUCTS

2.01 LOCAL AREA NETWORK (LAN)

A. An IEEE 802.3 ethernet local area network shall be used for communications between plant devices.

B. Network wiring shall be unshielded, twisted-pair copper cables for connections within buildings. Fiber optic media shall be used for all inter-device communication links extended outside of a building, unless specifically noted. Cables shall be as specified herein.

C. The Contractor shall provide appurtenances, including but not limited to, all hardware, cables, connectors, adapters, modules, and software, to implement a network as required for a fully functional system even if not explicitly specified or shown.

2.02 INDUSTRIAL ETHERNET NETWORK SWITCHES

A. An industrial Ethernet network switch shall be furnished by the instrumentation subcontractor in “PLC-4 RIO RACK 5” control panel and shall be integrated into the City’s existing plant Ethernet network. Integration work performed by the instrumentation and controls subcontractor shall include establishing communication between the “PLC-4 RIO RACK 5” Ethernet switch and the plant network, as well as coordinating IP address assignment with the City’s ICE Department. Once the control panel is installed and powered up at the site, the switch configuration shall be verified, and any required modifications shall be implemented to ensure full integration.

B. Except where specifically allowed on the Control System Block Drawing, industrial ethernet network switches shall be provided for each device connected to the process control system network. The switches shall create switched ethernet networks that conform to the IEEE 802.3 and 802.3u standards using copper wires or optical fibers in a bus, tree or ring network topology as shown on the Drawings. Ethernet network switches shall be modular, rack mounted, or standard DIN-rail mounted within the PLC cabinet or in an adjacent communication cabinet, as shown on the Drawings.

C. Ethernet network switches shall support ring, bus, star, or point-to-point network topologies. On-line signal monitoring shall be provided to detect and locate impending faults. Ethernet network switches shall be replaceable on-line without disrupting the network. Switches shall support Device Level Ring (DLR), which shall provide self-healing communication recovery.

D. Ethernet network switches shall meet the following minimum performance requirements:

1. Functions: Modular managed switch with store and forward switching mode, 10 Mbps ethernet, or 100 Mbps Fast-Ethernet, or gigabit Ethernet support, multi-address capability, auto-crossing, auto-negotiation, auto-polarity. Port speed and duplex auto-negotiation shall be configurable. Each network switch shall manage up to eight (8) ports possible via integrated media modules specified below.

2. Management: Simple Network Management Protocol (SNMP) (v1/v2/v3) and Common Industrial Protocol (CIP) support; IGMP filtering and snooping.

3. Power Requirements: Redundant 24 VDC power supply

4. Operating Temperature: 0 to 60 degrees C

5. Relative Humidity: 10 to 95%

6. Port Type & Quantity (at each PLC location): minimum of eight (8) 10/100Base-TX, twisted pair cable, RJ-45 sockets, 0-100 meters LAN segment and two (2) 100/1000Base-FX, single mode fiber optic LC sockets, 0-500 meters LAN segment.

7. Link Budget: 8 dB @ 1310 nm

8. Wavelength: 1310 nm

E. Acceptable industrial ethernet network switches shall be Fortinet FortiSwitch FSR-112D-POE Switch Rugged DIN rail type with FN-TRAN-LX SFP modules or Engineer approved equal.

2.03 CATEGORY 6 TWISTED PAIR CABLE

A. Twisted pair cable shall consist of 4 pair of 23-24 AWG copper conductors in a flame-retardant jacket. Cable shall be plenum rated (UL 910) and meet EIA/TIA-568 Category 6 (i.e., Cat6) specifications. Unshielded CAT 6 cable shall be Hyper Grade Extended Distance cable as manufactured by Berk-Tek, Belden equivalent, or equal. Cable shall include a foil shield grounded at one end where the cable enters VFD cabinets or other enclosures containing voltages higher than 120 VAC. Shielded CAT 6 cable shall be Category 6A Enhanced Cable F/UTP as manufactured by Belden or equal. Connectors shall be modular RJ-45 plug.

B. Solid conductors shall be used for all field wiring and punch-down applications. For patch cable applications and where installed-flexibility is necessary, such as for movable equipment or across enclosure door hinges, conductors shall be stranded.

C. For use as ethernet, Contractor’s conduit/cable routing shall be limited to the maximum ethernet length of 100m. If this cannot be accomplished, Contractor shall design and provide a system utilizing long-range copper extenders or fiber with media conversion or similar to overcome distance limitations, subject to Engineer’s approval.

D. Provide copper patch panels where more than one copper communication cable leaves the enclosure.

2.04 SINGLE-MODE FIBER OPTIC CABLE (OS2)

A. Fiber optic cable shall conform to ITU-T G.652.D and the following specifications:

1. Fiber Category: Single Mode, suitable for outdoor installation.

2. Fiber Count: 48 color-coded strands.

3. Construction: Loose-tube, water-swellable and single-armored.

4. Armor: Corrugated-steel (or equal) providing mechanical and rodent protection.

5. Maximum Attenuation:

   a. 0.4 dB/km at 1310 nm

   b. 0.3 dB/km at 1550 nm

6. Operating Temperature: -40 to 70 degrees C

7. Operating Relative Humidity: 0 to 100%

B. Fiber termination requirement:

1. Only 12 strands shall be terminated and tested at both ends for current use. Remaining 36 strands shall be reserved for future use. Fiber optic cable shall utilize mechanically spliced, field installable LC compatible connectors.

C. Fiber optic cable shall be Corning ALTOS Single-Armored Loose Tube Optical Cable, or approved equal by Phoenix Digital, Optical Cable Corporation, Belden or equivalent.

2.05 FIBER OPTIC PATCH PANELS

A. Upon entering a cabinet, panel or console, fiber optic cable shall be broken out using fan-out kits and terminated in a fiber optic patch panel. Fan-out kit shall provide mechanical connection to fiber optic cable jacket for strain relief and clean appearance. Where mechanical connection is not made or fan-out kit does not completely cover jacket, rip cords, dry block, material etc., fan-out kit shall be reinforced with short length of properly sized heat shrink tubing. Use of adhesive tape in this application shall not be permitted.

B. All fiber optic patch panels shall be mounted within a rack or a NEMA rated enclosure. Wall-mounting stand-alone patch panels shall not be permitted unless otherwise indicated.

C. Rack-mounted patch panels shall be Cabinet-Mounted Interconnect Center (C-MIC) as manufactured by Corning Cable Systems, equivalent by Black Box, Inc., Optical Cable Corporation, or equal.

D. Stand-alone patch panels shall be Wall-Mountable Interconnect Center (WIC) or Premises Interconnect Center (PIC) as manufactured by Corning Cable Systems, equivalent by Black Box, Inc., Optical Cable Corporation, or equal.

E. Fiber optic patch cable shall be provided at necessary lengths with a modal bandwidth (OM or OS) rating at least as high as the connected components.

PART 3 – EXECUTION

3.01 GENERAL REQUIREMENTS

A. The destination of all network data cables (both copper and fiber) leaving an enclosure, patch panel, or building shall be labeled at each end using industry-standard wire markers.

B. Refer to Section 40 61 13 – Process Control System General Provisions for additional requirements.

3.02 FIBER OPTIC CABLE

A. Fiber optic cable for installation within buildings shall comply with all applicable fire and building safety codes for such applications.

B. Fiber optic cable shall be installed in accordance with cable manufacturer's instructions.

C. Testing

1. Bulk fiber shall be tested on-site to prior to installation to provide a reference for the installed test data.

2. All individual fibers, including spares, shall be terminated and all connections shall be tested after installation.

3. Complete installed fiber optic cable shall be tested for continuity with a visual fault locator or fiber tracer and the connections verified and documented. Cabling shall also be tested for optical/insertion loss in compliance with Tier 1 testing per TIA-568.

4. Submit all test results.

3.03 FIBER OPTIC PATCH PANELS

A. All patch panels shall be labeled with destination/function of each port, matching terminology from the Contract Documents where possible. Provide printed directory mounted to or adjacent to patch panel with this information where sufficient space is not available.

END OF SECTION

SECTION 40 67 00
CONTROL SYSTEM EQUIPMENT PANELS AND RACKS

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish, test, install and place, in satisfactory operation the control enclosures, with all spare parts, accessories, and appurtenances.

B. Control enclosures shall be assembled, wired, and tested in the instrumentation subcontractor's own facilities, unless specified otherwise. All components and all necessary accessories such as power supplies, conditioning equipment, mounting hardware, signal input and output terminal blocks, and plug strips that may be required to complete the system shall be provided.

C. Either manufacturer's standard or custom enclosures may be furnished subject to the requirements of the Contract Documents and favorable review by the Owner.

D. Due consideration shall be given to installation requirements for enclosures in new and existing structures. The Contractor shall examine plans and field inspect new and existing structures as required to determine installation requirements and shall coordinate the installation of all enclosures with the Owner and all affected contractors. The Contractor shall be responsible for all costs associated with installation of enclosures, including repair of damage to structures (incidental, accidental or unavoidable).

E. The terms enclosure, cabinet, and panel shall be considered the same product and are used interchangeably. A rack, which may be freestanding or located within an enclosure, shall be interpreted to mean a 19-inch wide frame in compliance with the latest edition of EIA-310-D, Cabinets, Racks, Panels, and Associated Equipment.

1.02 SUBMITTALS

A. Submittals shall be per Section 40 61 15 – Process Control System Submittals.

B. Thermal calculations.

C. Proof of circuit breaker selective coordination.

1.03 RELATED WORK SPECIFIED ELSEWHERE

A. Section 40 61 13 – Process Control System General Provisions

B. Section 40 62 00 – Computer System Hardware and Ancillaries

C. Section 40 78 00 – Panel Mounted Instruments

D. Section 40 78 56 – Isolators, Intrinsically-Safe Barriers, and Surge Suppressors

E. Section 40 70 00 – Instrumentation for Process Systems

F. Section 40 61 90 – Schedules and Control Descriptions, General

G. Refer to Division 26 for additional requirements for conductors, circuit breakers, disconnect switches, etc.

1.04 PANEL LOCATION AND TYPE

A. For locations inside buildings in areas other than climate controlled (i.e., heated and air conditioned) electrical or control rooms, panel shall be Type 316 stainless steel NEMA 4X construction, or as indicated for hazardous area classification (Class, Division, at a minimum), or submersible, NEMA 6, applications. Epoxy coated cast copper-free aluminum construction shall also be acceptable for NEMA 4, 6 and 7 applications.

B. For locations in storage/feed areas for chlorine or other applicable corrosive chemicals, panel shall be of non-metallic construction, rated NEMA 4X, and be fully compatible with the associated chemical.

C. For locations within climate controlled (i.e., heated and air-conditioned) electrical or control rooms, panel shall be a painted steel fully enclosed NEMA 12 units with gasketed doors.

D. For outdoor locations, panel shall be Type 316L stainless steel NEMA 4X construction unless located in chlorine environments. Chlorine environment shall be nonmetallic NEMA 4X construction.

1.05 TOOLS, SUPPLIES AND SPARE PARTS

A. Tools, supplies and spare parts shall be provided as specified in Section 40 61 22 – Tools, Supplies and Spare Parts, General.

PART 2 – PRODUCTS

2.01 CABINETS AND PANELS

A. Unless otherwise specified, all control system enclosures shall be designed and constructed to comply with UL 508A, Industrial Control Panels and shall bear the UL mark.

B. Cabinets and panels shall be formed or welded construction, reinforced with strut (Unistrut, Powerstrut, or equal) to facilitate mounting of internal components or equipment. Sufficient access plates and doors shall be provided to facilitate maintenance and testing of the cabinet's equipment. Doors shall be removable. Cabinets and panels with any dimension 36 inches or greater shall be provided with removable lifting lugs designed to facilitate safe moving and lifting of the panel during installation. All doors shall be fitted with common-keyed locks.

C. Cabinets and panels shall be minimum 16 USS gauge. Cabinets and panels with any dimension greater than 36 inches shall be 14 USS gauge, except that reinforced modular cabinets may be constructed with 16-gauge walls and 14-gauge doors.

D. Cabinets and panels shall have doors on the front and shall be designed for front access. Cabinets with any dimension 42 inches or greater shall be fitted with three-point door latches. Doors for NEMA 4X cabinets shall be all stainless steel. Door hardware on NEMA 4X cabinets located in chemical storage/feed areas shall be non-corrosive in that environment.

E. Panels and cabinets located outside fence-secured areas shall be fitted with a staple and hasp. Provide padlock and coordinate keying with Owner.

F. All cabinets and panels shall be provided with drawing pockets for as-built panel drawings. One copy of the appropriate panel record drawings shall be furnished and left in the pocket of each panel.

G. Panels with any dimension greater than 36 inches that contain a programmable logic controller (PLC) shall be provided with a folding laptop programmer shelf on the outside of the door. When folded out for use, the laptop shelf shall not be greater than 48 inches above finished floor.

H. Panels with a PLC or a network switch shall be fitted with an exterior panel interface connector. While closed, the panel interface connector shall maintain the NEMA rating of the panel and be fitted with clear cover over a 120VAC GFCI-protected receptable and a RJ-45 Ethernet Port. Where necessary to connect directly to the PLC (if present), a type A female USB port shall also be present. Panel interface connector shall be by Grace Technologies. Affix adjacent nameplate reading, “PROGRAMMING PORT ONLY” with an indication of the receptacles maximum current rating.

I. Unless otherwise indicated, fasteners shall not penetrate the panel. All panel-mount or door-mount items that do not mount internally to a subpanel or internally via strut shall be mounted via factory applied weld-studs. Weld discoloration will not be accepted and shall be removed by passivating stainless materials or coating painted materials.

J. Unless otherwise noted, panel-mounted control devices (OITs, hand switches, etc.) requiring operator access shall be mounted between 48 and 60 inches above the floor or work platform.

K. Cabinets and panels shall be prefabricated cabinets and panels by nVent HOFFMAN, Saginaw Control and Engineering (SCE), or Rittal. The Contractor may optionally provide cabinets that are custom fabricated by the instrumentation subcontractor or by a reputable panel fabrication shop acceptable to the Engineer.

2.02 FIELD PANELS

A. Field panels for outdoor service shall be suitable for wall or pipe mounting. Panels shall

have the following features:

1. Hinged and foamed-in-place continuous gasketed door(s). Door material shall match enclosure and shall have three-point latches.

2. Field panels located outside fence-secured areas shall be fitted with a staple and hasp. Provide padlock and coordinate keying with Owner.

3. Thermal insulation and thermostatically controlled space heaters where required to prevent condensation or maintain environmental conditions for installed components.

4. External sun shields or shades constructed of the same materials as the associated enclosure, unless otherwise specified. Sun shield or shade shall be fitted to enclosure supports and not to enclosure. Sun shield or shade shall have a slightly sloped top to shed water and shall extend past the front of the enclosure by at least 6 inches and extend down the side and back of enclosure.

B. All external sample/process piping, including valves and appurtenances, shall be insulated with weather-proof insulation and heat-traced to prevent freezing. Heat tracing shall be thermostatically controlled and self-regulating, and shall adjust its heat output to the temperature of the process lines. Heat trace shall be powered from an equipment-safety GFCI circuit from within panel, unless otherwise shown or specified. An alarm contact from the heat trace system shall be made available for trouble indication.

C. Field panels shall be adequately sized to house instruments, power supplies, surge protection, and appurtenant equipment required for operation. Sufficient space shall be provided for servicing instruments without removal of equipment from the enclosure.

D. Field panels shall be as manufactured by nVent HOFFMAN, Saginaw Control & Engineering (SCE), Rittal or equal.

2.03 CABINET AIR CONDITIONING UNITS

A. Where indicated or required due to ambient conditions and panel component ratings, panel-mounted closed loop air conditioning units and thermostatically controlled space heaters shall be provided.

B. Air conditioning units shall both cool and dehumidify the cabinet's internal air. Each air conditioner shall be sized to handle current and future (with specified spare capacity filled) heat loadings from all equipment mounted inside the cabinet.

C. Air conditioners shall be provided with thermostats which operate the centrifugal evaporator blowers continuously to prevent stratification of air within the cabinet. Compressors shall operate as needed to maintain the temperature set at the thermostat. Compressors shall be provided with space heaters to maintain the compressor at a minimum temperature during cold ambient temperatures.

D. Ambient air shall be completely separated from the air inside the cabinet. All air conditioner components exposed to the atmosphere outside the cabinets shall be coated to prevent corrosion.

E. Power supply shall be 115VAC, 60 Hz. Units shall be provided with EMI/RFI noise suppressors.

F. Air conditioner enclosures shall be constructed of stainless steel or cold rolled steel which is phosphatized and finished in baked enamel.

G. Cabinet air conditioners shall be ProAir Series as manufactured by nVent HOFFMAN, or equal.

2.04 TERMINAL BLOCKS

A. Terminal blocks shall be assembled on non-current carrying galvanized steel DIN mounting rails securely bolted to the cabinet subpanel. Terminals shall be of the screw down pressure plate type as manufactured by Phoenix Contact, Weidmuller, Wieland, Square D, Allen-Bradley or equal.

B. Power terminal blocks for both 120 VAC and 24 VDC power shall be single tier with a minimum rating of 600 volts, 30 amps.

C. Signal terminal blocks shall be single tier with a minimum rating of 600 volts, 20 amps.

2.05 NAMEPLATES

A. Items of equipment installed in control panels shall be identified with nameplates. Each nameplate shall be located so that it is readable from the normal observation position and is clearly associated with the device or devices it identifies. Nameplates shall be positioned so that removal of the device for maintenance and repair shall not disturb the nameplate. Nameplates shall include, as necessary, the equipment identification number, description, calibrated range, and set point(s). Abbreviations of the description shall be subject to the Engineer's approval.

B. Nameplates shall be made of 1/16-inch thick machine engraved laminated phenolic plastic having white numbers and letters not less than 3/16-inch high on a black background. Nameplates attached to instruments may be black laser etched 1/8-inch high text on stainless steel with sharp edges made smooth. Stamped text shall not be acceptable.

C. Nameplates shall be attached to metal equipment by NEMA rated stainless steel screws and to other surfaces by an epoxy-based adhesive that is resistant to oil and moisture. In cases where the label cannot be attached by the above methods, it shall be drilled and attached to the associated device by means of a braided stainless steel wire affixed with a permanent crimp.

D. Submit sample nameplate of each type.

PART 3 – EXECUTION

3.01 FABRICATION

A. The cabinet itself and all interior and exterior equipment shall be identified with nameplates. The equipment shall be mounted such that service can occur without removal of other equipment. Face mounted equipment shall be flush or semi-flush mounted with flat black escutcheons. All equipment shall be accessible such that adjustments can be made while the equipment is in service and operating. All enclosures shall fit within the allocated space as shown on the Drawings.

B. Enclosures shall provide mounting for power supplies, control equipment, input/output subsystems, panel-mounted equipment and appurtenances. Ample space shall be provided between equipment to facilitate servicing and cooling.

C. Enclosures shall be sized to adequately dissipate heat generated by equipment mounted inside the panel. If required, one or more of the following shall be provided to facilitate cooling:

1. For NEMA 12 cabinets only, louvered openings near the bottom and top or thermostatically controlled, low-noise cooling fans to circulate outside air into the enclosure, exhausting through louvers near the top of the cabinet. Air velocities through the enclosure shall be minimized to assure quiet operation.

2. Thermostatically controlled, low noise internal air blowers to circulate air within the enclosure, maintaining a uniform internal temperature. Initial setpoint shall be 75 degrees F.

3. All intake openings in cabinets and panels shall be fitted with dust filters. Exhaust openings shall not be filtered.

D. Enclosures shall be constructed so that no screws or bolt heads are visible when viewed from the front. Punch cutouts for instruments and other devices shall be cut, punched, or drilled and smoothly finished with rounded edges.

E. The temperature inside each enclosure containing digital hardware (e.g., PLC, computer, Ethernet switch) shall be continuously monitored and shall generate an alarm to the nearest PLC if the temperature rises to an adjustable, preset high temperature. This thermostat shall be independent and separate from the thermostat used to control the temperature in the enclosure described above. Enclosure “high interior temperature” alarm shall be displayed on the HMI or OIT.

F. Intrusion alarm switches shall be provided on all enclosures containing digital hardware and shall generate an alarm to the nearest PLC when any enclosure door is opened. If panel contains a service light, alarm switch shall also be wired to turn light on when door is opened.

G. Terminals shall be marked with a permanent, continuous marking strip. One side of each terminal shall be reserved exclusively for field incoming conductors. Common connections and jumpers required for internal wiring shall not be made on the field side of the terminal. Subject to the approval of the Engineer, a vendor's pre-engineered and prefabricated wiring termination system will be acceptable.

H. A maximum of one conductor shall be placed under a single terminal unless the terminal manufacturer explicitly permits more than one conductor. The use of a double ferrule for multiple conductors shall be avoided where possible.

I. Wiring within cabinets, panels, and consoles shall be installed neatly and shall comply with accepted standard instrumentation and electrical practices. Power, control and signal wiring shall comply with Division 26 of the Specifications, except that the minimum wire size for discrete signal wiring may be 16 AWG, and for analog wiring may be 18 AWG. For each pair of parallel terminal blocks, the field wiring shall be between the blocks.

J. Separate terminal strips shall be provided for each type of power and signal used within each cabinet. Where applicable, terminal strips for different voltages of discrete signal wiring shall also be separated. Terminal strips shall be labeled as to voltage and function. Terminals for grounds, shields, grounding connections, and similar shall be green and placed adjacent to the terminals of the wiring of which it is associated with.

K. All wiring shall be bundled and run open or enclosed in vented plastic wireway as required. Wireways shall be oversized by a minimum of 10%; overfilled wireways shall not be acceptable. All conductors run open shall be bundled and bound at regular intervals, not exceeding 12 inches, with nylon cable ties and suitable supports. Care shall be taken to separate electronic signal, discrete signal, and power wiring when operating at differing voltages.

L. Spare field wiring shall be bundled, tied, and labeled as specified above, and shall be neatly coiled in the bottom of the cabinet.

M. All installed spare I/O hardware shall be wired along with live I/O wiring to the field wiring terminal blocks within the cabinet. Where space for spare I/O modules has been provided with the PLC backplane or DIN-rail mounting system, corresponding space for wiring, surge protection, and terminations shall be furnished within the cabinet.

N. A copper power ground bar shall be installed in each cabinet and shall be connected to the building power ground. An isolated copper signal ground bar shall be installed in each cabinet where analog or shielded signals are present. Isolated ground bar shall be connected to the power ground bus by a single #6 (or larger) bonding jumper where an isolated signal ground plane does not exist at the facility.

O. Interior panel wiring shall be tagged at all terminations with machine-printed self-laminating labels. Labeling system shall be Brady TLS 2200 Printer with TLS 2200®/TLS PC Link™ labels, or equivalent system by Seton or Panduit. The wire numbering system and identification tags shall be as specified in Section 26 05 19 – Low-Voltage Conductors

and Cables. Field wiring terminating in panels shall be labeled in accordance with the requirements of Section 26 05 19 – Low-Voltage Conductors and Cables. Where applicable, the wire number shall be the ID number listed in the input/output schedules.

P. Wires shall be color coded as follows:

1. Equipment Ground – GREEN
2. 120 VAC Power – BLACK
3. 120 VAC Power Neutral – WHITE
4. 120 VAC Control (Internally Powered) – RED
5. 120 VAC Control (Externally Powered) – YELLOW
6. 24 VAC Control – GRAY
7. DC Power (+) – BLUE
8. DC Power (-) – GRAY
9. DC Control – WHITE W/ BLUE STRIPE
10. Analog Signal – BLACK/WHITE or BLACK/RED

Q. Enclosures shall be provided with a main circuit breaker and a circuit breaker on each individual branch circuit distributed from the panel. Main breaker and branch breaker sizes shall be coordinated such that an overload in a circuit will trip only its immediate breaker and not the upstream breaker.

R. Enclosures with any dimension larger than 36 inches shall be provided with internal 120-volt duplex receptacles for service equipment and internal LED service light(s). Power to these devices shall be independent from the PLC power feed and its associated uninterruptible power system (UPS), where two circuits are present. Where a single circuit is present, these devices shall be powered before independent of the UPS.

S. Where applicable, enclosures shall be furnished with red laminated plastic warning signs in each section. The sign shall be inscribed "WARNING - This Device Is Connected to Multiple Sources of Power." Letters in the word "WARNING" shall be 0.75 inch high, white.

T. The interconnection between equipment and panel shall be by means of flexible cables provided to permit withdrawal of the equipment from the cabinet without disconnecting the plugs.

3.02 PAINTING/FINISHING

A. All steel enclosures shall be free from dirt, grease, and burrs and shall be treated with a

phosphatizing metal conditioner before painting. All surfaces shall be filled, sanded, and finish coated by spraying a 1-2 mil epoxy prime coat and smooth, level, high grade textured finish between flat and semi-gloss shine. The colors shall be selected by the Owner from a minimum of six color samples provided. Refer to Division 09 for additional requirements.

B. Materials and techniques shall be of types specifically designed to produce a finish of superior quality with respect to adherence, as well as impact and corrosion resistance.

C. Panels fabricated from stainless steel shall not be painted. Where indicated, stainless steel shall be permitted to be powder coated.

D. Panels fabricated from non-metallic materials (e.g., FRP) shall be gel-coated and shall not be otherwise painted.

E. Panels located outdoors shall be colored white, unless otherwise indicated.

3.03 INSTALLATION

A. Refer to Section 40 61 13 – Process Control System General Provisions for additional requirements.

END OF SECTION

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SECTION 40 67 63
UNINTERRUPTIBLE POWER SYSTEMS

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish, test, install and place in satisfactory operation all uninterruptible power systems, with all spare parts, accessories, and appurtenances as herein specified and as shown on the Drawings.

B. One UPS shall be provided for each operator workstation and its peripherals (i.e. printer, network equipment, radio, etc.) provided under this Contract.

C. One UPS shall be provided for each programmable logic controller (PLC) panel or remote I/O (RIO) panel and its appurtenant equipment provided under this Contract. However, courtesy receptacles in PLC and RIO cabinets shall not be powered by the UPS.

D. UPS units shall be mounted in or near enclosures containing digital hardware, unless otherwise specified or shown on the Drawings, as follows:

1. UPS units for operator's consoles shall be mounted within the consoles.

2. UPS units for control panels containing PLCs or RIOs shall be mounted either within the cabinet or in an adjacent cabinet of suitable environmental rating.

3. UPS units for RTUs shall be mounted within the RTU cabinet.

E. Where the UPS is mounted within a dedicated enclosure, that enclosure shall be properly sized for heat dissipation and all other applicable requirements as specified in Section 40 67 00 – Control System Equipment Panels and Racks and its subordinate Sections.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 40 61 13 – Process Control System General Provisions

B. Section 40 62 00 – Computer System Hardware and Ancillaries

C. Section 40 63 43 – Programmable Logic Controllers

1.03 SUBMITTALS

A. Sizing calculations, in Watts (W) or Volt-Amps (VA), for all UPS units.

B. Heat dissipation calculations for all enclosures that contain a UPS unit.

C. Run time calculation.

PART 2 – EQUIPMENT

2.01 UNINTERRUPTIBLE POWER SYSTEMS

A. Each UPS shall consist of a freestanding UPS module and battery modules as required to meet backup run time requirements.

B. UPS units shall be true on-line type. Each UPS shall be sized to match the maximum power requirements of the associated digital equipment, control panel power supplies and accessories. Under normal operation, the AC power shall be converted to DC. The DC power from the battery charger shall supply an inverter and maintain the battery module at full charge. The AC output from the inverter shall be fed to the associated digital equipment power supply unit and/or other equipment power supplies as appropriate. Upon loss of the AC supply, the inverter shall continue to supply normal power to the device, drawing DC from the batteries.

C. An automatic bypass switch shall be provided with UPS units of greater than 2 kVA capacity. The transfer switch shall be of the solid state, make-before-break type and shall automatically transfer load from the inverter to the AC line in the event of an inverter malfunction. The total transfer time shall be 5 milliseconds or less. The transfer switch shall be provided with a manual override.

D. A manually operated maintenance bypass switch shall be provided for each UPS installation, other than for computers, to allow the hardware to be powered while the UPS is removed for maintenance. The bypass switch shall be the make-before-break type to ensure continuous power to the load.

E. Loss of AC power shall be monitored on the line side of the UPS and reported via normally closed (fail safe) unpowered contacts to the associated PLC/RTU.

F. Each UPS shall meet the following requirements:

1. Input voltage shall be 117 VAC, single phase, 60 Hz.

2. Voltage regulation shall be +/-5 percent for line and load changes.

3. The output frequency shall be phase-locked to the input AC line on AC operation and shall be 60 hertz +/-0.5 percent when on battery operation.

4. The batteries shall be of the sealed, lead acid or lead calcium gelled electrolyte type, or VRLA absorbed glass mat (AGM) type. The battery modules shall have a minimum full load backup time of 30 minutes for PLC-based control panels, and 45 minutes for remote telemetry units.

5. The UPS capacity shall be sized for 150% of the connected load.

6. Ethernet/IP communications and add-on instruction capability that allows for integration with Schneider Elecxtric PLC software.

7. A status monitoring and control panel shall be provided and shall include the following:

    a. Status indicating lights for both normal and abnormal conditions.

    b. Individual alarm contacts that shall close upon:

        1) Loss of the AC line

        2) Low battery level

        3) Fault condition.

    c. Contacts shall be wired to the closest discrete input subsystem. Alternatively, an RS-232 or USB port shall provide UPS status to an operator workstation. All required interface software and hardware shall be provided.

    d. Circuit breaker for the AC input.

8. Sound absorbing enclosure.

9. EMI/RF noise filtering.

10. Surge protection shall be provided on the AC input circuit, which shall have a UL TVSS clamping voltage rating of 400 V with a <5 ns response time.

G. UPS systems shall be the 9PX series by Eaton, Smart-UPS On-line series by APC/Schneider-Electric, or equal.

PART 3 – EXECUTION

3.01 REQUIREMENTS

A. Where the UPS is mounted within the PLC or RIO cabinet, it shall not interfere with access to other equipment or wiring within the panel (i.e., it shall not be necessary to move or remove the UPS to remove or service other panel-mounted equipment). For floor-mounted PLC cabinets with bottom wiring access (including those cabinets with legs), the UPS shall be placed on a dedicated shelf within the cabinet.

B. Refer to Section 40 61 13 – Process Control System General Provisions for additional requirements.

END OF SECTION

SECTION 40 68 00.13
PROCESS CONTROL SOFTWARE (MODIFY EXISTING)

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish, test, install, and place in satisfactory operation all control and information system software with all required programming and software appurtenances as herein specified and as shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 40 61 13 – Process Control System General Provisions

B. Section 40 61 93 – Control System Input/Output List

C. Section 40 61 96 – Process Control Descriptions

PART 2 – PRODUCTS - (NOT USED)

PART 3 – EXECUTION

3.01 OVERALL SYSTEM CONFIGURATION

A. The Owner's existing Human-Machine Interface (HMI) software, including but not limited to all relevant displays, alarm summary pages, data collection, and historical trending/reporting, shall be modified to include all work performed under this Contract. Contractor shall be responsible for gathering the existing software to be modified, investigating the correct software version to be used as well as any software patches needed to provide a fully functional control system.

B. The Owner's existing control system shall be modified to include the inputs and outputs specified in the Input/Output Schedule and in other Sections of this Division.

3.02 SOFTWARE MODIFICATIONS

A. All HMI software configuration performed under this Contract shall be coordinated with the Owner and shall match in all possible respects the "look and feel," in the opinion of the Engineer, of the existing SCADA System. Specified features and functions of this Contract that do not already exist, even if only for "look and feel," shall be provided. Details on how to best implement these features and functions shall be discussed with Owner and Engineer.

B. Major HMI software scope of work shall include, but shall not be limited to, the following:

1. Create new graphic displays showing the new facilities and functions described herein complete with all associated equipment and instrumentation.

2. Modify the existing plant overview display(s) for the SCADA system to include the new facilities and equipment and create links to the new screens.

3. Modify existing alarm summary pages to incorporate new monitoring data into the alarm displays.

4. Modify existing reports to include the additional monitoring points specified under this Contract.

5. Create new real-time and historical trends, and coordinate with the Owner appropriate grouping of the trend charts.

6. Update the system status display to include new hardware provided under this Contract.

C. All discrete and analog data acquisition, pre-processing, storage and process control functions shall be performed at the PLC level. The HMI software shall not be used for this purpose.

END OF SECTION

SECTION 40 70 00
INSTRUMENTATION FOR PROCESS SYSTEMS

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The instrumentation subcontractor shall furnish, install, test and place in operation instruments as scheduled together with all signal converters, transmitters, isolators, amplifiers, etc. to interface with the process control system as shown on the Drawings and as specified. The Contractor may elect to install sensors on process lines provided that the instrumentation subcontractor provides full on-site supervision during installation. Mounting of associated indicators, sensors, sampling pumps, power supplies, brackets and appurtenances shall be provided as indicated.

B. It is the intent of the Contract Documents that all process taps, isolation valves, nipples, penetrations, embedded instrumentation supports, conduit, wiring, terminations, and the installation of process instrumentation on process lines shall be provided under this Contract. The Instrumentation Subcontractor shall supervise installation of equipment provided where installation is by other Subcontractors or Contractors.

C. Tapping and connections for primary process sensors shall be sized to suit each individual installation and the requirements of the instrument served. The Contractor shall ensure that the location, supports, orientation and dimensions of the connections and tapping for instruments are such as to provide the proper bracing, the required accuracy of measurement, protection of the sensor from accidental damage and accessibility for maintenance while the plant is in operation. Isolation valves shall be provided at all process taps.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 40 61 13 – Process Control System General Provisions

B. Section 40 61 91 – Process Control System Instrument List

C. Section 40 67 00 – Control System Equipment Panels and Racks

D. Section 40 79 00 – Miscellaneous Instruments, Valves, and Fittings

E. Section 40 61 22 – Tools, Supplies, and Spare Parts, General

F. Instruments furnished with mechanical equipment shall be furnished, installed, tested and calibrated as specified elsewhere in the Contract Documents.

1.03 TOOLS, SUPPLIES AND SPARE PARTS

A. Tools, supplies and spare parts shall be provided as specified in Section 40 61 22 -- Tools, Supplies, and Spare Parts, General.

B. Additional items as recommended by the analytical instrument manufacturers or as described for the specified analytical instrument sections shall be provided.

PART 2 – PRODUCTS

2.01 GENERAL

A. All instrumentation supplied shall be the manufacturer's latest design. Unless otherwise specified, instruments shall be solid state, electronic, using enclosures to suit specified environmental conditions. Microprocessor-based equipment shall be supplied unless otherwise specified. All instruments shall be provided with mounting hardware and floor stands, wall brackets, or instrument racks as shown on the Drawings, or as required.

B. Equipment installed in a hazardous area shall meet or exceed Class, Group, and Division requirements as shown on the Drawings, to comply with the National Electrical Code.

C. All field instrumentation for outdoor service shall be provided with enclosures that are suitable for outdoor service, as follows:

1. Where the manufacturer's enclosures are suitable for outdoor service, they shall be provided with instrument sunshades. Sunshades shall be Style E as manufactured by O'Brien Corporation, or equal. Where possible, these instruments shall be mounted in a north facing direction.

2. Where the manufacturer's standard enclosures are not suitable for outdoor service, instruments shall be mounted in Field Panels in accordance with Section 40 67 00 – Control System Equipment Panels and Racks, or may be furnished with Vipak instrument field enclosures as manufactured by O'Brien Corporation, equivalent by Intertec, or equal. It shall not be necessary to provide the manufacturer's NEMA 4 or 4X enclosures for instruments that will be subsequently mounted in separate field panels.

D. All instruments shall return to accurate measurement without manual resetting upon restoration of power after a power failure.

E. Unless otherwise shown or specified, local indicators shall be provided for all instruments. Where instruments are located in inaccessible locations, local indicators shall be provided and shall be mounted as specified in Paragraph 3.01 B herein. All indicator readouts shall be linear in process units. Readouts of 0 to 100% shall not be acceptable (except for speed and valve position). Isolated outputs shall be provided for all transmitters.

F. Unless otherwise specified, field instrument and power supply enclosures shall be Type 316 stainless steel, fiberglass (or similar, per Engineer's judgement) or PVC coated copper-free cast aluminum NEMA 4X construction.

G. Where separate elements and transmitters are required, they shall be fully matched, and unless otherwise noted, installed adjacent to the sensor. Special cables or equipment shall be supplied by the associated equipment manufacturer.

H. Electronic equipment shall utilize printed circuitry and shall be coated (tropicalized) to prevent contamination by dust, moisture and fungus. Solid state components shall be conservatively rated for long term performance and dependability over ambient atmosphere fluctuations. Ambient conditions shall be -20 to 50 degrees C and 20 to 100 percent relative humidity, unless otherwise specified. Field mounted equipment and system components shall be designed for installation in dusty, humid, and corrosive service conditions.

I. All devices furnished hereunder shall be heavy duty type, designed for continuous industrial service. The system shall contain products of a single manufacturer, insofar as possible, and shall consist of equipment models that are currently in production. All equipment provided, where applicable, shall be of modular construction and shall be capable of field expansion.

J. All non-loop-powered instruments and equipment shall be designed to operate on a 60 Hz AC power source at a nominal 117 V, plus or minus 10 percent, except where specifically noted. All regulators and power supplies required for compliance with the above shall be provided. Where equipment requires voltage regulation, constant voltage transformers shall be supplied.

K. All analog transmitter and controller outputs shall be isolated, 4 to 20 milliamps into a load of 0 to 750 ohms, unless specifically noted otherwise. All switches shall have double pole, double throw contacts rated at a minimum of 600 VA, unless specified otherwise.

L. Materials and equipment used shall be UL approved wherever such approved equipment and materials are available.

PART 3 – EXECUTION

3.01 INSTALLATION

A. General

1. Equipment shall be located so that it is accessible for operation and maintenance. The instrumentation subcontractor shall examine the Drawings and shop drawings for various items of equipment in order to determine the best arrangement for the work as a whole and shall supervise the installation of process instrumentation supplied under this Division.

2. Work shall be performed in compliance with all applicable local codes and practices. Where the Contract Documents do not delineate precise installation procedures, the latest version of the American Petroleum Institute (API) Recommended Practice 551 manual (API RP 551) shall be used as a guide to installation procedures.

B. Equipment Mounting and Support

1. Field equipment shall be wall mounted or mounted on two inch diameter pipe stands welded to a 10 inch square by 1/2 inch thick base plate unless shown adjacent to a wall or otherwise noted. Materials of construction shall be aluminum or 316 stainless steel. Instruments attached directly to concrete shall be spaced out from the mounting surface not less than 1/2 inch by use of phenolic spacers. Expansion anchors in walls shall be used for securing equipment or wall supports to concrete surfaces. Unless otherwise noted, field instruments shall be mounted between 48 and 60 inches above the floor or work platform.

2. Embedded pipe supports and sleeves shall be Schedule 40, Type 316 stainless steel pipe, ASA B 36.19, with stainless steel blind flange for equipment mounting, unless otherwise indicated.

3. Materials for miscellaneous mounting brackets and supports shall be Type 316 stainless steel construction.

4. Pipe stands, miscellaneous mounting brackets and supports shall comply with the requirements of Division 05 of the specifications.

5. Transmitters shall be oriented such that output indicators are readily visible.

C. Control and Signal Wiring

1. Electrical, control and signal wiring connections to transmitters and elements mounted on process piping or equipment shall be made through liquid tight flexible conduit. Conduit seals shall be provided where conduits enter all field instrument enclosures and all cabinetry housing electrical or electronic equipment.

3.02 ADJUSTMENT AND CLEANING

A. The instrumentation subcontractor shall comply with the requirements of Division 01 of these Specifications and all instrumentation and control system tests, inspection, and calibration requirements for all instrumentation and controls provided under this Contract and specified herein. The Engineer, or his/her designated representative(s), reserves the right to witness any test, inspection, calibration or start up activity. Acceptance by the Engineer of plans, reports, or documentation relating to testing or commissioning activity shall not relieve the Contractor of his/her responsibility for meeting all specified requirements.

B. The instrumentation subcontractor shall provide the services of factory trained technicians, tools and equipment to field calibrate, test, inspect and adjust each instrument to its specified performance requirement in accordance with manufacturer's specifications and instructions. Instruments which fails to meet Contract requirements, or published manufacturer performance specification for functional and operational parameters, shall be repaired or replaced, at the discretion of the Engineer, at no cost to the Owner. The Contractor shall bear all costs and provide all personnel, equipment and materials necessary to implement all installation tests and inspection activities for equipment specified herein.

C. At least 60 days before the anticipated initiation of installation testing, the Contractor shall submit to the Engineer a detailed description of the installation test(s) to be conducted to demonstrate the correct operation of the instrumentation supplied hereunder.

D. Field instrument calibration shall conform to the following requirements:

1. The instrumentation subcontractor shall provide the services of factory trained instrumentation technicians, tools and equipment to field calibrate or verify factory calibration of each instrument supplied under this Contract and existing instruments shown to its specified accuracy in accordance with the manufacturer's specification and instructions for calibration. Calibration and verification shall take place under actual process conditions. Forcing outputs shall not be acceptable.

2. Each instrument shall be calibrated/verified at 0, 25, 50, 75 and 100 percent of span using test instruments to simulate inputs and read outputs. Test instruments shall be rated to an accuracy of at least five (5) times greater than the specified accuracy of the instrument being calibrated. Where applicable, such test instruments shall have accuracy’s as set forth by the National Institute for Standards and Technology (NIST).

3. The instrumentation subcontractor shall provide a written calibration/verification sheet to the Engineer for each instrument, certifying that it has been calibrated to its published specified accuracy. The Contractor shall submit proposed calibration sheets for various types of instruments for Engineer approval prior to the start of calibration. This sheet shall include but not be limited to date, instrument tag numbers, brief description of how the calibration process was performed, calibration data for the various procedures described herein, name of person performing the calibration, a listing of the published specified accuracy, permissible tolerance at each point of calibration, calibration reading as finally adjusted within tolerance, defect noted, corrective action required and corrections made. For electronic or powered instruments, the calibration/verification sheet shall also list all configurable parameters that have been modified from their default factory setting.

4. If doubt exists as to the correct method for calibrating or checking the calibration/verification of an instrument, the manufacturer's printed

recommendations shall be used as an acceptable standard, subject to the approval of the Engineer.

5. Upon completion of calibration, devices calibrated hereunder shall not be subjected to adjustments, sudden movements, accelerations, or shocks, and shall be installed in permanent protected positions not subject to moisture, dirt, and excessive temperature variations. Caution shall be exercised to prevent such devices from being subjected to over-voltages, incorrect voltages, overpressure or incorrect air. Damaged equipment shall be replaced and re-calibrated/verified at no cost to the Owner. Equipment that has been adjusted, modified, or moved or there is evidence of such activity shall be re-calibrated/verified at no cost to the Owner.

6. After completion of instrumentation installation, the instrumentation subcontractor shall perform a loop check. The Contractor shall submit final loop test results with all instruments listed in the loop. Loop test results shall be signed by all representatives involved for each loop test.

END OF SECTION

SECTION 40 71 39
PADDLE WHEEL INSERTION FLOW METERS

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish, test, install and place in satisfactory operation the paddle wheel insertion flow meters, with all spare parts, accessories, and appurtenances as herein specified and as shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 40 61 13 – Process Control System General Provisions

B. Section 40 70 00 – Instrumentation for Process Systems

PART 2 – PRODUCTS

2.01 PADDLE WHEEL INSERTION FLOW SENSORS – BATTERY OPERATED

A. The sensor shall be a Paddle wheel type with integral magnets producing pulses sensed by internal electronics. A microprocessor shall calculate and display flow rate and totalized volume as shown on the Drawings.

B. No external power shall be required. The battery shall be capable of a minimum five (5) years continuous service. Battery compartment shall remain sealed to maintain the enclosure rating.

C. Display Functions:

1. Integral LCD indicating instantaneous flow rate in GPM, LPM, or other selectable engineering units.

2. Non-resettable lifetime totalizer.

3. Resettable batch totalizer.

D. Accuracy: ±1.5 percent of full scale.

E. Linearity: ±1.5 percent of full scale.

F. Repeatability: ±1 percent of full scale.

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G. Operating Pressure/Temperature: Rated for service on Schedule 40 or Schedule 80 PVC piping up to 150 psi at 73 °F (23 °C). Ambient operating temperature range 20 °F to 130 °F (–6 °C to 54 °C).

H. Meter bodies and wetted materials shall be compatible with chlorinated (<10 ppm) non-potable water.

I. Enclosure: Waterproof, NEMA 4X (IP66) minimum.

J. Provide factory calibration for pipe size and schedule indicated. Contractor shall field-verify accuracy and adjust “percent adjust” factor as required to meet specified accuracy.

K. Flowmeter shall be WM-PT Series as manufactured by Assured Automation or engineer approved equal.

PART 3 – EXECUTION

3.01 REQUIREMENTS

A. Refer to Section 40 70 00 – Instrumentation for Process Systems.

END OF SECTION

SECTION 40 71 79.16

FLOW SWITCHES (THERMAL)

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish, test, install and place in satisfactory operation the thermal dispersion flow switches, with all spare parts, accessories, and appurtenances as herein specified and as shown on the Drawings.

B. Contractor shall be responsible for coordinating process line size to match capabilities of the selected instrument. In consultation with Engineer, small diameter line sizes shall be increased in size as required to meet velocity requirements of the instrument. At no additional cost, provide reducers and increase process line size in the same material in a straight segment of pipe for a length no less than manufacturer's recommended length of straight run.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 40 61 13 – Process Control System General Provisions

B. Section 40 70 00 – Instrumentation for Process Systems

PART 2 – PRODUCTS

2.01 THERMAL DISPERSION FLOW SWITCHES – INSERTION TYPE

A. Each flow switch shall utilize a thermal dispersion type, Hastelloy C sensing element (probe) or other manufacturer-recommended material compatible with sodium hypochlorite, installed in the process piping as indicated on the Drawings. Probe style and material shall be as determined by the manufacturer and based on the chemical and process application.

B. Unless otherwise indicated or recommended by the manufacturer, the element insertion length shall be approximately one-third to one-half of the pipe diameter plus allowance for mounting accessories. All mounting accessories shall be provided by the manufacturer.

C. The electronics shall be mounted to the sensor, unless otherwise indicated. Power supply to the unit shall be 120 VAC, 60 Hz. Where remote mounted, manufacturer shall furnish a continuous length of cable between the sensor and the electronics.

D. The instrument shall be housed in a NEMA 4X (IP66) enclosure and shall be rated for a Class I, Division 1 or Division 2 environment, per the Area Classification Drawings, when located in a hazardous area.

E. The unit shall have field configurable dual SPDT or single DPDT relay contacts rated 6 amps at 115 VAC for remote alarming.

F. Flow repeatability shall be ±0.5% of reading.

G. Flow response time shall be as low as 3 seconds.

H. The thermal dispersion flow switch shall be Fluid Components Model (FCI) FLT93 series, Sierra InnovaSwitch, Magnetrol Thermatel TD2 series, or equal.

PART 3 – EXECUTION

3.01 REQUIREMENTS

A. All threaded connections between stainless steel components shall be installed with process compatible anti-seize lubricant to prevent galling.

B. Refer to Section 40 70 00 – Instrumentation for Process Systems, for additional information

END OF SECTION

SECTION 40 72 23.01
RADAR LEVEL METERS – TWO-WIRE

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish, test, install and place in satisfactory operation the radar liquid level measurement systems, with all spare parts, accessories, and appurtenances as herein specified and as shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 40 61 13 – Process Control System General Provisions

B. Section 40 70 00 – Instrumentation for Process Systems

PART 2 – PRODUCTS

2.01 RADAR LEVEL MEASUREMENT SYSTEM

A. Each radar level monitoring system shall include one radar level transmitter sensor with microprocessor-based signal conditioning.

B. Tank mounting applications shall include a threaded or flange process connection, with mounting accessories supplied by the manufacturer, compatible with the process liquid and the tank connection.

C. For mounting applications, the sensor shall include an integrated antenna suitable for narrow beam measurement.

D. The system shall be capable of measuring up to 26 ft.

E. Process connections: Thread 1 ½ “ and 1”.

F. The system shall be suitable for operating temperature range of -40 to +140 degrees F and pressure of full vacuum to 43.5 psi.

G. The level sensor shall operate on the W-band frequency (80 GHz). Sensor accuracy shall be a minimum of 0.2 inches. Beam spread shall be 8 degrees or less.

H. Output level signal shall be two-wire, 4 to 20 mA.

I. Power requirement for the sensor/transmitter shall be 12 to 35 VDC, two wire loop powered.

J. The units shall have a NEMA 4X housing of PBT plastic. Wetted parts shall be PVDF with

FKM process seal.

K. All elements shall be Factory Mutual certified for use in Class 1, Division 1, Groups C and D.

L. System setup shall be by Bluetooth wireless technology, HART communicator or vendor supplied software communicating over the signal wiring.

M. Each radar level sensor/transmitter unit shall be a LR100 series model 7ML5307-1AA06-0AA0 as manufactured by Siemens or Engineer Approved Equivalent.

PART 3 – EXECUTION

3.01 REQUIREMENTS

A. Refer to Section 40 70 00 – Instrumentation for Process Systems.

END OF SECTION

SECTION 40 72 73
SIGHT LEVEL GAUGES

1.01 THE REQUIREMENT

A. The Contractor shall furnish, test, install and place in satisfactory operation the sight level gauges, with all spare parts, accessories, and appurtenances as herein specified and as shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 40 61 13 – Process Control System General Provisions

B. Section 40 61 91 - Process Control System Instrument List

C. Section 40 70 00 – Instrumentation for Process Systems

D. Section 43 41 43 – Polyethylene Storage Tanks

PART 2 – PRODUCTS

2.01 REVERSE FLOAT LEVEL GAUGES

A. Each sodium hypochlorite storage tank shall be equipped with a Reverse Float Level Gauge designed to provide visual level indication.

B. The system shall consist of a large, rotationally molded float that rides inside the tank and a brightly colored external target indicator that moves inversely to the float position. When the tank is full, the target shall be positioned at the bo4om of the tank, and when the tank is empty, the target shall be at the top, in clear view.

C. The level gauge shall have the following specifications:

1. Length: Shall be per Section 40 61 91 – Process Control System Instrument List.

2. Units: Shall be per Section 40 61 91 – Process Control System Instrument List.

3. Mounting: The level gauge shall be securely mounted to the top of the tank and along the exterior wall in accordance with the manufacturer's recommendations.

4. Materials: All materials shall be non-metallic and chemically compatible with sodium hypochlorite.

D. The gauge shall be the reverse float level gauge by Assmann Corporation or engineer approved equal.

PART 3 – EXECUTION

3.01 REQUIREMENTS

A. Refer to Section 40 70 00 – Instrumentation for Process Systems.

END OF SECTION

SECTION 40 72 76.26
LEVEL SWITCHES (SLIDING TYPE)

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish, test, install and place in satisfactory operation the float level switches, with all spare parts, accessories, and appurtenances as herein specified and as shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 40 61 13 – Process Control System General Provisions

B. Section 40 70 00 – Instrumentation for Process Systems

1.03 TOOLS, SUPPLIES AND SPARE PARTS

A. Tools, supplies and spare parts shall be provided as specified in Section 40 61 22 – Tools, Supplies, and Spare Parts, General. In addition, the following specific spare parts items shall be provided:

1. One of each type of level switch sensor.

PART 2 – PRODUCTS

2.01 LEVEL SWITCHES (SLIDING TYPE)

A. Chemical Service - level switches shall be of the direct acting float-operated design, comprised of a hermetically sealed float assembly that slides vertically on a column containing micro switches with a cable for connecting into a water tight electrical junction Box.

B. Micro switches shall be one normally open, 5A-115V AC capacity. Float hangers and supports shall be provided as shown on the manufacturer's installation detail drawings.

C. Float switches for leak detection of chemicals in containment sumps shall be Teflon LS-1900TFE Series Single-Point Level Switch as manufactured by Gems Sensors, or equal.

PART 3 – EXECUTION

3.01 REQUIREMENTS

A. Refer to Section 40 70 00 – Instrumentation for Process Systems.

END OF SECTION

SECTION 40 73 13
PRESSURE AND DIFFERENTIAL PRESSURE GAUGES

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish, test, install and place in satisfactory operation the pressure gauges, with all spare parts, accessories, and appurtenances as herein specified and as shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 40 61 13 – Process Control System General Provisions

B. Section 40 70 00 – Instrumentation for Process Systems

C. Section 40 79 00 – Miscellaneous Instruments, Valves, and Fittings

PART 2 – PRODUCTS

2.01 PRESSURE GAUGES

A. All gauges shall be designed in accordance with the ASME B40.1 entitled, "Gauges, Pressure, Indicating Dial Type - Elastic Element".

B. All gauges shall be direct reading type. Snubbers shall be provided on all gauges. Gauge full-scale pressure range shall be selected such that the maximum operating pressure shall not exceed approximately 75% of the full-scale range.

C. Features

1. Mounting: ½” NPT, lower stem mount type
2. Accuracy: 0.5% full scale
3. Case: Solid front, black phenolic material
4. Dial: White background and black letters
5. Glass: Shatterproof
6. Blow-out protection: Back
7. Pressure element: stainless steel bourdon tube

8. Movement: Stainless steel, Teflon coated pinion gear and segment

9. Gaskets: Buna-N

D. Liquid-filled or equivalent mechanically-damped gauges shall be used if the gauges are installed with pumps, or where gauges are subjected to vibrations or pulsation. Filling fluid shall be silicone unless oxidizing agents such as sodium hypochlorite are present, where halocarbon shall be used.

E. Gauge size shall be 4-1/2".

F. Diaphragm seals and isolating ring seals shall be furnished in accordance with the requirements specified under Section 40 79 00 – Miscellaneous Instruments, Valves, and Fittings.

G. The complete gauge assembly and appurtenances shall be fully assembled and tested prior to field mounting. A ½" isolation stainless steel ball valve shall be provided for each gauge assembly.

H. Pressure and vacuum gauges shall be Ashcroft Duragauge Model 1279, Ametek-U.S. Gauge Division, H.O. Trerice Co., WIKA Instrument Corporation, or equal.

PART 3 – EXECUTION

3.01 REQUIREMENTS

A. Refer to Section 40 70 00 – Instrumentation for Process Systems.

END OF SECTION

SECTION 40 78 00
PANEL MOUNTED INSTRUMENTS

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish, test, install and place in satisfactory operation the panel mounted instruments, with all spare parts, accessories, and appurtenances as specified herein and as shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 40 61 13 – Control and Information System Scope and General Requirements

B. Section 40 62 00 – Computer System Hardware and Ancillaries

C. Section 40 67 00 – Control System Equipment Panels and Racks

1.03 GENERAL INFORMATION AND DESCRIPTION

A. All equipment mounted on the face of a panel shall conform to the same NEMA rating specified for the panel construction.

1.04 TOOLS, SUPPLIES AND SPARE PARTS

A. Tools, supplies and spare parts shall be provided as specified in Section 40 61 22 – Tools, Supplies, and Spare Parts, General. In addition, the following specific spare parts items shall be provided:

1. One of each type of panel mounted equipment (i.e., process indicators, pilot devices, push buttons, signal converters, etc.) provided under this Contract.

2. Five of each type of fuse and interposing control relay provided under this Contract.

PART 2 – PRODUCTS

2.01 OPERATORS

A. Control operators shall be 30.5 mm, round, heavy-duty, oil tight NEMA 4X corrosion resistant. For Hazardous areas, control operators shall be rated NEMA 7.

B. Pushbuttons shall be non-illuminated, spring release type. Pushbuttons shall include a full guard. Panic stop/alarm pushbuttons shall be red mushroom type with manual-pull

release. Selector switches shall be non-illuminated, maintained contact type, unless otherwise indicated.

C. Pilot lights shall be of the proper control voltage, push-to-test LED type with lens and LED lamp colors as specified below.

1. Red: stopped, off, or closed

2. Green: running, on, or opened

3. Amber: fault, alarm, or warning

4. White: generic non-alarm status

5. Blue: control power on

D. Control operators shall have legend plates as specified herein, indicated on the Drawings, or otherwise directed by the Engineer. Legend plates shall be plastic, black field (background) with white lettering. Engraved nameplates shall be securely fastened above each control operator. If adequate space is not available, the nameplate shall be mounted below the operator.

E. Control operators for all equipment under this Contract shall be of the same type and manufacturer unless otherwise indicated. Control operators such as pushbuttons (PB), selector switches (SS), and pilot lights (PL) shall be Cutler-Hammer/Westinghouse Type E34, Square D Company Type SK, or equal

2.02 ELECTRONIC INDICATORS

A. Electronic indicators shall be 3.5 or 6 digit, as appropriate, with 0.56" high red LED display. Indicators shall be provided with nameplate and scale calibrated to match the calibration of the primary element. The unit shall be designed primarily for use with 4-20 mA current loop signal circuits. Indicator operating voltage shall be 115 VAC 10%, 60 Hz. Indicator controls shall include three (3) front-panel pushbuttons for modifying alarm values and other indicator setup. Two (2) form-C relays shall be provided for each indicator. Relay contact outputs shall be rated 5A, 120/240 VAC, resistive load. Where required, a regulated and isolated 24 V excitation power supply shall be provided. Indicators shall be suitable for indoor or outdoor service as required and shall have the same NEMA enclosure rating as the associated enclosure.

B. Indicators shall be Precision Digital Model PD765 Trident, or equal.

2.03 RELAYS

A. Interposing control relays (CR)

1. Where required to interface between motor control centers, equipment controls, and control panels, interposing relays and associated control wiring circuitry shall be furnished and installed to provide the monitoring and/or control functions specified herein.

2. Interposing relays shall be small format type, DPDT, minimum 10 amp, 120 VAC contact rating.

3. Relay coils shall be 120 VAC or 24 VDC as required to interface with equipment.

4. Relays shall have a flag indicator to show relay status, a pushbutton to allow manual operation of the relay, and an internal pilot light to indicate power to the coil.

5. Relays shall be as manufactured by Square D, Potter & Brumfield, Allen-Bradley, or equal.

B. Timing Relays (TR)

1. Timing relays shall be electronic type with 120 VAC coils unless otherwise specified or indicated on the Drawings. Timers shall be provided with a minimum of two SPDT timed output contacts and instantaneous contacts where required. Contact ratings shall be the same as for interposing relays.

2. Timing relays shall be the general purpose plug-in type, Type JCK as manufactured by Square D Company, equivalent by Eaton/Cutler-Hammer, equivalent by Allen-Bradley, or equal.

2.04 TOTALIZERS

A. Totalizing counters shall be provided for flush panel, spring-clip mounting. Face dimensions of the totalizing counters shall be no larger than 1-1/8-inches high by 2-inches wide. Totalizing counters shall contain eight digits. Height of the digits shall not be less than 5/32-inch. Numerals shall be white on a black background. The counter shall be non-resettable and shall be totally compatible for operation on the pulses supplied by the associated instrument or integrator. The totalizing counter shall be capable of a maximum count rate of 25 counts/second.

B. Legend plates shall be provided for each of the totalizing counters with white letters on a black background with legends as specified below.

C. Totalizing counters shall be manufactured by Kessler-Ellis, or equal.

2.05 ALARM HORNS

A. Alarm horns shall be general-purpose type, panel-mounted, and shall be suitable for indoor or weatherproof service, as required. Power supply shall be either 115 VAC or 24

VDC. Horns shall be capable of producing 100 dB at 10 feet and shall have adjustable volume.

B. Horns shall be Vibratone series as manufactured by Federal Signal Corporation, McMaster-Carr equivalent, Edwards Signaling Company equivalent, or equal.

PART 3 – EXECUTION

3.01 REQUIREMENTS

A. Refer to Section 40 67 00 – Control System Equipment Panels and Racks, for additional requirements.

END OF SECTION

SECTION 40 78 56
ISOLATORS, INTRINSICALLY-SAFE BARRIERS, AND SURGE SUPPRESSORS

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish, install, and place in satisfactory operation the isolators, intrinsically-safe barriers, and surge protection devices (SPDs) as specified herein and as shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 40 61 13 – Control and Information System Scope and General Requirements

B. Section 40 62 00 – Control and Information System Hardware, General

C. Section 40 67 00 – Control System Equipment Panels and Racks

D. Section 40 78 00 – Panel Mounted Instruments

1.03 TOOLS, SUPPLIES AND SPARE PARTS

A. Tools, supplies and spare parts shall be provided as specified in Section 40 61 22 – Tools, Supplies, and Spare Parts, General.

B. In addition, the following specific spare parts items shall be provided:

1. Five of each type of surge protection device provided under this Contract.

PART 2 – PRODUCTS

2.01 SURGE PROTECTION

A. General

1. All electrical and electronic elements shall be protected against damage due to electrical transients induced in interconnecting lines from lightning discharges and nearby electrical systems.

2. Manufacturer's Requirements: All surge protection devices shall be manufactured by a company that has been engaged in the design, development, and manufacture of such devices for at least 5 years. Acceptable manufacturers shall be Phoenix Contact, Edco, Transtector, Weidmuller, or equal.

3. Surge protection device installations shall comply with UL 94, the National Electric Code (NEC), and all applicable local codes.

4. Surge protection devices shall be installed as close to the equipment to be protected as practically possible.

5. Device Locations: As a minimum, provide surge protection devices at the following locations:

    a. At connections between AC power and electrical/electronic equipment, including, but not limited to, panels, assemblies, and field mounted analog transmitters.

    b. At both ends of signal circuits that have any portion of the circuit extending outside of a building.

    c. At both ends of copper-based communication cables which extend outside of a building, including at field instruments and the field side of analog valve position signals.

    d. On all external telephone communication lines.

B. AC power protection

1. Surge protection device assemblies for connections to AC power supply circuits shall:

    a. Be provided with two 3-terminal barrier terminal strips capable of accepting No. 12 AWG solids or stranded copper wire. One terminal strip shall be located on each end of the unit.

    b. Have a nonflammable enclosure that meets or exceeds UL 94 V0 flammability requirements. The surge protection device shall be provided with provisions for mounting to interior of equipment racks, cabinets, or to the exterior of freestanding equipment.

    c. Be constructed as multistage devices consisting of gas tube arrestors, high energy metal oxide varistors, or silicon avalanche suppression diodes. Assemblies shall automatically recover from surge events and shall have status indication lights.

    d. Comply with all requirements of UL 1449, latest edition.

    e. Be able to withstand a peak surge current of 10,000 amps based on a test surge waveform with an 8-microsecond rise time and a 20-microsecond exponential decay time, as defined in UL 1449.

f. Have the following characteristics:

1) Maximum Continuous Operating Voltage: 150VAC

2) Maximum Operating Current: 20 amps

3) Ambient Temperature Range: -20 degrees C to +65 degrees C

4) Response Time: 5 nanoseconds

C. 24 VDC analog and discrete signal circuit protection:

1. Surge protection device assemblies for analog signal circuits shall:

a. Have four lead devices with DIN Rail mounting.

b. Have a nonflammable enclosure that meets or exceeds UL 94 V0 flammability requirements.

c. Be constructed as multistage devices consisting of gas tube arrestors and silicon avalanche suppression diodes. Gas tube arrestors and diodes shall be separated by a series impedance of no more than 20 ohms. Assemblies shall automatically recover from surge events.

d. Comply with all requirements of UL 497B.

e. Be able to withstand a peak surge current of 10,000 amps based on a test surge waveform with an 8-microsecond rise time and a 20-microsecond exponential decay time, as defined in UL 1449.

f. Limit line-to-line voltage to 40 volts on 24VDC circuits.

g. Have the following characteristics:

1) Maximum Continuous Operating Voltage: 28VDC

2) Ambient Temperature Range: -20 degrees C to +65 degrees C

3) Response Time (Line-to-Line): 5 ns

D. Communication circuit protection

1. Surge protection devices for copper-based data communication circuits shall:

a. Be designed for the specific data communication media and protocol to be protected (e.g., telephone, serial, parallel, network, data highway, coax, twinaxial, twisted pair, RF).

b. Provide protection of equipment to within the equipment's surge withstand levels for applicable standard test wave forms of the following standards:

1) IEC 60-1 / DIN VDE 0432 part 2

2) CCITT K17 / DIN VDE 0845 part 2

3) IEEE C62.31

c. Have a nonflammable enclosure that meets or exceeds UL 94 V0 flammability requirements.

d. Provide automatic recovery.

2.02 INTRINSICALLY SAFE BARRIERS AND RELAYS

A. Intrinsically safe relays and barriers shall be provided where required to interface with equipment located in Classified (i.e., hazardous) areas.

B. Intrinsically safe relays and barriers shall be FM approved.

C. Manufacturer shall be

1. Pepperl+Fuchs

2. Crouse Hinds

3. Square D

4. Or equal.

2.03 ISOLATORS AND CONVERTERS

A. Signal converters shall be provided as required to provide control functions and to interface instrumentation and controls, equipment panels, motor control centers and other instrumentation and controls supplied under other Divisions to the controls provided herein.

B. General Requirements

1. Converters shall be of the miniature type, utilizing all solid-state circuitry suitable for mounting within new or existing cabinetry. Where sufficient cabinet space is not available, sub panels or supplemental enclosures shall be provided.

2. Power supply shall be 120V, 60 hertz where required by the converter, unless otherwise indicated.

3. Repeatability shall be 0.1% of span, deadband shall be 0.1% span, maximum.

4. Where specific converters are not listed, but are required to interface with the process control system, they shall comply with the general requirements stated herein.

C. Current to Current (I/I) Isolators

1. Current to current isolators shall be furnished where necessary to provide an isolated current loop, calculations or signal amplification between the plant process control system and instrumentation and control loops. Isolators shall be sized such that resistance of existing loops shall not exceed maximum rated resistance.

2. Isolators shall be as manufactured by AGM, Moore Industries, Rochester Instrument Systems (RIS), Phoenix Contact, Weidmuller, Acromag, or equal.

D. Voltage to Current (E/I) Transducers

1. Voltage to current (or current to voltage) transducers shall convert a voltage signal of one magnitude to a 4 20 milliamp DC current signal. The output current shall be directly proportional to the input signal voltage. Transducers shall be sized such that loop resistance does not exceed maximum rated resistance.

2. Transducers shall be as manufactured by AGM, Moore Industries, Rochester Instrument Systems (RIS), Phoenix Contact, Weidmuller, Acromag, or equal.

E. Frequency to Current (F/I) Transducers

1. Frequency to current transducers shall convert pulse rate and pulse duration signals to 4 20 mA, 24 VDC analog signals. Converters shall include field adjustable input frequency range. Converter power shall be 120 VAC, 60 hertz. Transducers shall be sized such that loop resistance does not exceed maximum rated resistance. Transducers shall be suitable for signal transmission via leased telephone lines.

2. Transducers shall be Series 5100 as manufactured by AGM, or equivalent by Moore Industries, Rochester Instrument Systems (RIS), Phoenix Contact, Weidmuller, Acromag, or equal.

F. Current to Frequency (I/F) Transducers

1. Current to frequency transducers shall convert 4 20 mA, 24 VDC analog signals to pulse rate and pulse duration signals. Converters shall include field adjustable output frequency range. Converter power shall be 120 VAC, 60 hertz. Transducers shall be sized such that loop resistance does not exceed maximum rated resistance. Transducers shall be suitable for signal transmission via leased telephone lines.

2. Transducers shall be Series 5016 as manufactured by AGM, Moore Industries, Rochester Instrument Systems (RIS), Phoenix Contact, Weidmuller, Acromag, or equal.

G. Integrators

1. Integrators shall be provided as interchangeable plug in modules with zero and span adjustment available on the front plate of the units. Output shall range from 0 to 0.1 through 0 to 10 pulses per second. Accuracy shall be + 0.1% of input span. Integrators shall convert linear analog signals to pulse rate and provide a solid state output.

2. Integrators shall be as manufactured by AGM Electronics, Moore Industries, Rochester Instrument Systems (RIS), Phoenix Contact, Weidmuller, Acromag, or equal.

H. Electronic Switches (Alarm Relays)

1. Electronic switches shall be furnished with a calibrated dial for adjusting set points. The input to the switch shall be 4 - 20 mA DC, and the set point shall be adjustable over the full range. Unless otherwise noted, the dead band shall be fixed at less than 2% of span. The set point stability shall be +0.1% per degree F. The repeatability shall be +0.1% of span. The units shall be furnished with SPDT relays rated at 10 amperes at 115 VAC.

2. Electronic switches shall be as manufactured by AGM, Moore Industries, Rochester Instrument Systems (RIS), Phoenix Contact, Weidmuller, Acromag, or equal.

I. RTD to Current Signal Converters

1. RTD to current signal converters shall convert a 3-wire RTD input signal to an isolated 4 20 mADC output signal. Accuracy shall be 0.10% of span or better. Calibrated span of each converter shall be as indicated on the instrument list. The Contractor shall coordinate calibration of the signal converters with existing RTD elements.

2. Signal converters shall be as manufactured by AGM, Moore Industries, Rochester Instrument Systems (RIS), Phoenix Contact, Weidmuller, Acromag, or equal.

PART 3 – EXECUTION

3.01 REQUIREMENTS

A. See Section 40 78 00 – Panel Instruments and Accessories, for additional requirements.

END OF SECTION

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SECTION 40 78 59
POWER SUPPLIES

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish, test, install and place in satisfactory operation all power supplies, with all spare parts, accessories, and appurtenances as herein specified and as shown on the Drawings.

B. All power conditioners shall be mounted within consoles or control panels containing the associated digital equipment unless otherwise specified or shown on the Drawings.

C. One power conditioner shall be provided for each PLC cabinet provided under this Contract.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 40 61 13 – Process Control System General Provisions

B. Section 40 62 00 – Computer System Hardware and Ancillaries

C. Section 40 63 43 – Programmable Logic Controllers

PART 2 – EQUIPMENT

2.01 POWER CONDITIONERS

A. Each power conditioner shall be sized to match the maximum power requirements of the associated digital equipment, control panel power supplies and accessories.

B. Each power conditioner shall meet the following requirements:

1. Input voltage shall be 120 VAC, single phase, 60 Hz.

2. Voltage regulation shall be ∀3% for line changes of +10%/-20%.

3. Total harmonic distortion shall be less than 3% of RMS.

4. Ambient operating temperature shall be from -20 to 50 degrees C.

C. Power conditioners shall be Sola Model MCR, or equal.

PART 3 – EXECUTION

3.01 REQUIREMENTS

A. Refer to Section 40 61 13 – Process Control System General Provisions.

END OF SECTION

SECTION 40 79 00

MISCELLANEOUS INSTRUMENTS, VALVES, AND FITTINGS

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish, test, install and place in satisfactory operation, the instrumentation and control system accessories with all spare parts, and appurtenances as herein specified and as shown on the Drawings.

B. Accessories include various items of equipment that may be required in the system but are not scheduled. Accessories are shown on details, flow sheets or plans. Accessories are also called out in specifications for scheduled instruments and in the installation specifications. It is not intended, however, that each piece of hardware required will be specifically described herein. This Specification shall be used as a guide to qualify requirements for miscellaneous hardware whether the specific item is described or not.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 40 61 13 – Process Control System General Provisions

B. Section 40 70 00 – Instrumentation for Process Systems

1.03 SUBMITTALS

A. Per Section 40 61 15 – Process Control System Submittals

B. Impulse piping layout and routing drawings

C. Complete instrument assembly drawings showing orientation to installed process piping.

PART 2 – PRODUCTS

2.01 PROCESS TUBING

A. Process, impulse, or capillary tubing shall be 1/2 x 0.065-inch seamless, annealed, ASTM A-269 Type 316L stainless steel with 37 degrees Type 316 stainless steel flared fittings or Swagelock or Parker-CPI flareless fittings.

B. Piping for closely coupling instruments to process seals shall be standard stainless steel NPT threaded piping or NPT tapped mounting blocks.

C. A nickel-based lubricant shall be used on threaded stainless steel piping connections to prevent galling.

2.02 POWER, CONTROL, AND SIGNAL CABLES

A. Power, control, and signal wiring shall be provided under Division 26 of the Specifications, unless otherwise indicated.

2.03 CHEMICAL DIAPHRAGM SEALS

A. Diaphragm seals shall be provided for isolation of pressure gauges, switches and transmitters attached to systems containing chemical solutions or corrosive fluids. As a minimum, seals shall be of all 316 stainless steel construction. In general, diaphragms shall be 316L stainless steel for operating pressures at or above 15 psi and elastomers for operating pressures below 15 psi. However, all components shall be non-reactive with the process fluid in all cases. Refer to the Process Control System Instrument Lists for specific materials requirements.

B. Seal shall have fill connection, 1/4-inch NPT valved flush port and capable of disassembly without loss of filler fluid. Where specified, diaphragm seals shall comply with the above requirements and shall be provided with 316 SS factory filled capillaries.

C. Seals shall be Helicoid Type 100 HA, Mansfield & Green, Ashcroft, or equal.

2.04 ISOLATING RING SEALS

A. For solids bearing fluids, line pressure shall be sensed by a flexible cylinder lining and transmitted via a captive sensing liquid to the associated pressure sensing instrument(s).

1. Full Line Size Isolating Ring Seals

    a. Where indicated, the sensor body shall be full line size wafer design.

    b. Full line size isolating ring seals shall have 316 stainless steel housing and assembly flanges and Buna N flexible cylinder lining for in line mounting. The wafer shall have through bolt holes or centerline gauge for positive alignment with the associated flanged piping. Gauge or readout shall be oriented for viewing.

    c. The captive liquid chamber and associated instrument(s) shall be furnished with threaded drain tap and plug. Manufacturer shall furnish seals with a quick-disconnect-type fitting for field disassembly and reassembly, however, seal and instruments shall be factory assembled prior to arriving at the job site

    d. Isolating ring seals shall be Onyx Isolator Ring, or equal.

2. Tapped Isolating Ring Seals

    a. Where indicated, pressure shall be sensed via a minimum 1-1/2" diameter spool type isolating ring seal mounted on a 1-1/2" pipe nipple at 90 degrees from the process piping.

b. An isolation ball valve shall be provided between the process piping and the ring seal, and a cleanout ball valve shall be provided between the ring seal and the atmosphere. The factory assembled and filled pressure instrument shall be back or side mounted to the ring seal such that the gauge or readout may be viewed normally.

c. Tapped isolating ring seals for solids service shall be Red Valve Series 42/742, Ronningen Petter Iso Spool, Onyx Isolator Ring, or equal.

B. Sealed pressure instrumentation assembles shall be factory assembled and calibration tested by an authorized entity of the manufacturer.

2.05 FILLING MEDIUM:

A. The filling medium between instruments, isolating ring seals and diaphragm seals shall be a liquid suitable for operation in an ambient temperature ranging from -10 degrees F to +150 degrees F.

B. Filling medium shall be silicone unless oxidizing agents, such as sodium hypochlorite, are present, then halocarbon shall be used.

2.06 TAMPER EVIDENT PAINT

A. Piping and screwed/bolted connections of instrumentation containing the filling medium shall be marked with a small continuous tick mark of tamper evident paint over each piping/instrument joint. Tamper evident paint shall be applied prior to instrument assemblies arriving on the job site. Disturbance of the joint shall break the paint.

B. Instrument assemblies with broken paint or missing paint shall not be accepted and shall be repaired or replaced at no additional cost to Owner. Paint shall be Dykem Cross-Check or equal.

2.07 ISOLATION VALVES

A. Isolation valves shall be 1/2 inch diameter ball valves, unless otherwise indicated, with a Type 316 stainless steel body, Type 316 stainless steel ball. Where 316 stainless steel is not compatible with the process fluid, materials of construction shall be suitable for the associated process fluid (e.g., PVC for chemical service).

2.08 ALARM ANNUNCIATION DEVICE

A. Sirens:

1. For Class I, Division 2 areas and non-hazardous areas:

a. Provide NEMA 4X and Class I, Division 2 rated alarm horn capable of 32 selectable warning tones. Coordinate tone selection with Owner. Volume shall be field adjustable between 0 and 114 dBA measured at 10 feet.

b. Alarm horn shall be the SelecTone 302GCX series with UTM tone module as manufactured by Federal Signal Corporation.

2. For Class I, Division 1 areas:

a. Provide NEMA 4X and Class I, Division 1 rated alarm horn capable of 32 selectable warning tones. Coordinate tone selection with Owner. Volume shall be field adjustable between 0 and 114 dBA measured at 10 feet.

b. Alarm horn shall be the SelecTone 302X series with UTM tone module as manufactured by Federal Signal Corporation.

B. Strobe Lights:

1. Strobes located within the same room, or otherwise visible from any shared frame of view, shall be synchronized per the requirements of NFPA 72. Strobes shall by synchronized by the strobe manufacturer's synchronization module. Strobe circuits shall not exceed the continuous duty current rating of the synchronization module. Synchronization module shall be Federal Signal Model SSM, Edwards Signaling Model EG1M-RM, or equal.

2. For Class I, Division 2 areas and non-hazardous areas:

a. Provide red strobe status indicator. Unit shall be rated NEMA 4X and Factory Mutual approved for a Class I, Division 2, Group D area. Unit shall contain a durable polycarbonate housing and be surface mount. Unit shall be UL listed. Strobe shall be powered from 24VDC.

b. Alarm strobe shall be Federal Signal Model 225XST, Edwards Signaling Model 116DEGEX-FJ, or equal.

3. For Class I, Division 1 areas:

a. Provide red explosion proof dome covered strobe unit rated NEMA 4X and Factory Mutual certified for a Class I, Division 1, Group D area. Unit shall be UL listed. Strobe shall be powered from 24VDC.

b. Alarm strobe shall be Federal Signal Model 27XST, Edwards Signaling Model 116DEGEX-FJ, or equal. Compatible mounting hardware by the strobe manufacturer shall be furnished.

4. Lens color shall be as indicated on the Drawings.

PART 3 – EXECUTION

3.01 REQUIREMENTS

A. Refer to Section 40 70 00 – Instrumentation for Process Systems.

END OF SECTION

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DIVISION 43 – PROCESS GAS, LIQUID HANDLING, AND STORAGE EQUIPMENT

SECTION 43 41 43
POLYETHYLENE STORAGE TANKS

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish, deliver, install, test and place in satisfactory operation cross-linked high-density polyethylene dual walled storage tanks, complete with all necessary accessories, at the locations shown on the Drawings and as specified herein.

B. Equipment shall be provided in accordance with the requirements of Section 46 00 00 – Equipment General Provisions.

1.02 CONDITIONS OF SERVICE/STORAGE TANK SCHEDULE

A. Chemical Properties

	(Liquid) Sodium Hypochlorite
Concentration	12.5%
Specific Gravity	1.17
pH	11.5-<13.5
Freezing Point	7 °F

B. Storage Tank Schedule (See Drawings for orientation):

Parameter	**6,650-gal Bulk Storage Tank**	**Elevation**
Number of Tanks	Six (6)	--
Tank Identification No.	See Drawings	--
Ambient Temperature Range	40-100 degrees F	--
Type	Vertical, Cylindrical, Dual-Wall	--
Bottom Configuration	Flat Bottom	--
Top Configuration	Dome Top	--
Nominal Capacity (to top of straight shell)	7,300 gallons	--
Usable Capacity (top of outlet to 6” below invert of overflow)	6,650 gallons	--
Maximum Diameter	10'-2"	--
Maximum Straight Shell Height	12’-4”	--

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Parameter	6,650-gal Bulk Storage Tank	Elevation
Maximum Overall Height	14’-3”	--
Connection Openings:		
1) Fill	2"	Top Flat
2) Transfer Pump Fill	2"	Top Flat
3) Outlet - Metering Pump Suction	3" Bolted One-Piece Sure Seal with Flexible Dual-Wall Transition Containment	Lower Sidewall
4) Overflow	3"	Upper Side Flat
5) Vent Size and Type	8" U-Vent with vent screen	Top Flat
6) Manway Diameter and Type	2'-0" with integral 8” Safe Surge Vent	Top Flat
7) Continuous Level Instrument	6"	Top Dome
8) Reverse Float Level Gauge	To be provided by Manufacturer	Top Dome
Heating Panels and Insulation	No	--
Submergence Depth for Tank and Tie-Down Buoyancy Design	Tanks will not be submerged	--

C. Materials of Construction of Metals and Elastomers

	Sodium Hypochlorite
Anchor Clips or Plates / Cables	Coated 316 SS / SS
Anchor Bolts and Submerged Metals	Titanium or Hastelloy C-276
Non-Submerged Metals	316 SS
Elastomers	FKM

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. American National Standards Institute (ANSI)

1. ANSI B16.5 – Pipe Flanges and Flanged Fittings.

B. American Society of Testing Materials (ASTM)

1. ASTM D638 – Standard Test Methods for Tensile Properties of Plastics.

2. ASTM D746 – Brittleness Temperature of Plastics and Elastomers by Impact.

3. ASTM D790 – Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.

4. ASTM D883 – Standard Definitions of Terms Relating to Plastics.

5. ASTM D1505 – Density of Plastics by the Density-Gradient Technique.

6. ASTM D1525 – Vicat Softening Temperature of Plastics.

7. ASTM D1693 – ESCR Spec. Thickness .125" F50-10% Igepal.

8. ASTM D1998 – Standard Specification for Polyethylene Upright Storage Tanks.

1.04 SUBMITTALS

A. The following items shall be submitted in accordance with, or in addition to the submittal requirements specified in Section 01 33 00 – Submittal Procedures and Section 46 00 00 – Equipment General Provisions:

1. Shop Drawings

2. O&M Manuals

3. Warranty

4. List of at least five similar installations of the tank type, size, chemical service, and location conditions being proposed, including date installed, contact name, address and phone number Warranty

5. Dimensions of each tank, and dimensions, location, and orientation of openings, fittings, accessories, attachments, restraints and supports, manways, and flexible connections

6. Weight of each tank

7. Detailed instructions for pipe connections and bolt torque values

8. Design calculations supplied by the tank manufacturer or Contractor as applicable, signed by a Professional Engineer, for tank restraint system to withstand seismic, wind, and buoyancy conditions as required, including details for anchorage, lateral restraint, foundation requirements, and anchor bolt sizes, depth of embedment, shear, and pullout strength

9. Drawing details for ladder as recommended by Manufacturer and conforming with OSHA standards

10. Wall thickness calculations per ASTM D 1998 using 600 psi design hoop stress @ 100°F

11. A complete manufacturer's specification of the resin used

12. Factory test report, including wall thickness verification, fitting placement verification, visual inspection, impact test, gel test, and hydrostatic test

13. Statement that materials, resin, and fittings used are suitable for intended service

14. Statement that fabrication is in accordance with these Specifications

15. Instructions for handling, storage, loading and unloading, and installation of tanks

16. Inspection and testing reports as specified in Part 3 – Execution

1.05 QUALITY ASSURANCE

A. Tanks shall be constructed by a firm that has at least ten years prior experience in construction of similar polyethylene tanks in similar applications.

1.06 WARRANTY AND GUARANTEE

A. Warranty and Guarantee shall be as specified in Section 46 00 00 – Equipment General Provisions with the exception that the warranty period shall be for five (5) years, non-prorated, full replacement.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. The polyethylene storage tank(s) shall be as manufactured by Poly Processing Company, Assmann Inc., or equal.

2.02 MATERIALS AND CONSTRUCTION

A. Each tank shall be a Tanks shall be rotationally molded, high density cross-linked polyethylene, double wall, flat bottom tank. The double-wall assembly shall consist of one cylindrical, closed top inner primary tank and one cylindrical, open top containment outer tank. Each tank shall be a rotationally molded one-piece seamless constructed tank. The double-wall tanks shall be designed for above-ground, vertical installation and designed to store the chemical listed in Article 1.02 A., at atmospheric pressures.

B. The double-wall tank assembly shall be designed to prevent rainwater and debris from entering the containment tank. Tank shall have a specific gravity rating of 1.9 and shall be completely resistant to corrosion by the specified chemicals. The Contractor and tank manufacturer shall be fully responsible for the structural design and integrity and watertightness of the tank, including all anchorages and connections. Each tank shall be capable of storing the specified chemical at temperatures up to 130°F.

C. Tank resin shall include an antioxidant polyethylene system bonded to the interior surface during the manufacturing process.

D. The plastic shall not contain any fillers. All plastic shall contain a long-term UV stabilizer.

E. The nominal properties of the material are as follows based on molded parts:

Property	ASTM Specification	Value
Density	D1505 or D792	0.943 to 0.946 g/cc
ESCR Condition A, F50 100% Igepal 10% Igepal	D1693	 F_0 > 1,000 hours F_0 > 1,000 hours
Tensile Strength at Yield 2 in/min	D638	2,700 – 2,900 psi
Elongation at Break 2 in/min.	D638	640 percent
Flexural Modulus	D790	87,000 psi
Impact Strength, -40 °C	ARM	71 ft-lbs
Deflection Temperature @ 66 psi	D648	157 °F

F. Design Requirements

1. The minimum required wall thickness of the cylindrical shell at any fluid level shall be determined by the following equation, but shall not be less than 0.187 in thick.

T	=	P x O.D./2 SD = 0.433 x S.G. x H x O.D./2 SD
T	=	wall thickness
SD	=	Hydrostatic design stress, PSI
P	=	pressure (.433 x S.G. x H), PSI
H	=	fluid head, ft.
S.G.	=	specific gravity, g/cm∧3
O.D.	=	outside diameter, in.

2. The hydrostatic design stress shall be determined by multiplying the hydrostatic design basis, determined by ASTM D2837 using rotationally molded samples, with a service factor selected for the application. The hydrostatic design stress is 600 PSI at 73 degrees Fahrenheit.

3. The hydrostatic design stress shall be derated for service above 100 degrees Fahrenheit and for mechanical loading of the tank.

4. The standard design specific gravity shall be as noted in Section 2.02.A.

5. The minimum required wall thickness for the cylinder shell must be sufficient to support its own weight in an upright position without any external support.

6. For dome top tanks, the top head must be integrally molded with the cylinder shell. The minimum thickness of the top head shall be equal to the top of the straight wall. For open top tanks, the open top shall include a reinforcing flange provided for attaching a flat, hinged top. The minimum thickness of the flat top shall be equal to the top of the straight wall.

G. All tank capacities (volumes) specified shall include only that volume in the straight shell below the maximum tank fill level (6” below the overflow pipe invert elevation) and above the top of the outlet pipe.

H. Tanks shall be anchored to the concrete base by the Contractor in accordance with the Drawings.

2.03 CONNECTIONS AND ACCESSORIES

A. All connections/openings shall be flanged in accordance with ANSI B 16.5 150 pounds. Flanged connections, nozzles and openings shall be perpendicular to the straight shell of the tank. All pipe supports, hardware, accessories, etc., shall be provided. All piping connected to the tanks shall be perpendicular or parallel to the straight shell of the tanks. All piping into the tanks shall be supported such that no weight is placed on the tank and its connections. Piping or equipment supports requiring holes through the side wall of the tanks shall not be allowed.

B. Each tank outlet connection shall be provided with an isolation valve by the Contractor. Isolation valve shall be connected directly to the tank nozzle as indicated on the Drawings. Valve shall be independently supported such that closing and opening of the valve does not transmit torque load onto the tank nozzle.

C. Each tank connection located on the lower third of the tank shall be provided with a expansion joint / flexible connector resistant to the specified chemical to allow for lateral and vertical expansion and contraction of the tank and to isolate the tank from pump and piping vibration. Expansion joints / flexible connectors shall be provided by the tank manufacturer.

1. Expansion joints shall be constructed of 100% virgin PTFE resin with stainless steel limit cables and FRP composite flanges. Expansion joints shall have a minimum of three convolutions.

2. Expansion joints shall meet the following minimum performance requirements:

a. Axial Compression ≥ 0.67”

b. Axial Extension ≥ 0.67”

c. Lateral Deflection ≥ 0.51”

d. Angular Deflection ≥ 14º

e. Torsional Rotation ≥ 4º

3. Expansion joints shall be PTFE Flexijoint as manufactured by Andronaco Industries, or equal.

D. Fittings located in the flat part of tank tops shall be bolted flange CPVC with polyethylene-, EPDM-, or FKM-, as required, encapsulated bolts or bolted one-piece polyethylene with backing ring designed to reduce stress on the fitting. Bolts and gaskets shall be constructed of materials as shown in Section 1.02.

E. Dome fittings shall be threaded self-aligning ball socket design equipped with a flange adapter or fabricated PVC or CVPC vertical pipe welded to an angled plate and attached to the dome using polyethylene-encapsulated bolts, and equipped with a flange adapter. Bolts and gaskets shall be constructed of materials as shown in Section 1.02.

F. Vent lines shall be top-mounted. Each vent shall be extended to the atmosphere and shall have a PVC vent insect screen. Vent lines shall be supplied and installed by the Contractor as required or as directed by the Engineer.

G. Each bulk storage tank fill line shall be provided with a cam lock type quick connect coupling as shown on the Drawings for connection to the delivery vehicle. Quick connect couplings shall be provided by the Contractor as specified in Section 40 05 01 – Pipe and Valve Accessories. The Contractor shall furnish and install a sign at each chemical fill station to identify the chemical filled. The signage shall be as specified in Section 10 14 00 – Identifying Devices.

H. Each tank shall be provided with an overflow pipe as specified and indicated on the Drawings. The Contractor shall provide a Duckbill Valve for the overflow pipe of each storage tank, as shown on the Drawings or specified herein. The Duckbill Valves shall be as specified in Section 40 05 65.23 – Check Valves.

I. Each tank shall be provided with level instruments in accordance with Division 40 – Process Interconnections. The mounting and connecting requirements, including mounting flange diameter, required clearance between mounting flange and tank wall, and height above liquid level, shall be coordinated with the Instrument Supplier or as indicated on the Drawings and in this Section.

J. The tank manufacturer shall provide a reverse float level gauge for each tank as shown on the Drawings and as indicated in Section 1.02. The level indicator shall be assembled

to the tank and shall consist of PVC float, indicator, polypropylene rope, perforated interior pipe, PVC roller guides, clear UV resistant PVC sight tube, and necessary pipe supports. Supports for gauge shall not be permitted through the side wall as indicated in Section 2.03.A. Contractor shall coordinate with tank manufacturer to provide necessary support. The level indicator shall act inversely to the tank contents and shall not allow entrance of tank contents into the sight tube at any time. Indicator shall be easily visible for operators.

K. Each tank shall be provided with a top-mounted chemically-resistant manway. Manway covers shall be as indicated in Section 1.02.

L. Access Ladder – All tanks over five feet in height shall be equipped with an exterior access ladder for access to the manway. The ladders shall be constructed of materials that are completely resistant to corrosion by the specified chemical; FRP ladders shall be all vinyl ester construction. Ladder shall meet OSHA requirements, including allowable distance from the floor to the first rung. Bottom of ladder shall be mounted to tank pad or floor of tank area as shown on the Drawings. Ladder shall provide 18 inches between side rails and 12 inches between rungs. Angle clips shall be furnished for mounting the bottom of the ladder to the concrete pad or grating. Ladders shall be furnished with gooseneck handrails at the top. Ladder shall be provided with platform approximately 2'-0" below straight shell height. The tank top shall be equipped with ladder clips to bolt ladder handrails thereto. Ladder clips shall be resistant to corrosion by the specified chemicals. Ladders must be mounted to the tank to allow for tank expansion and contraction due to temperature and loading changes. Ladder supports requiring holes through the side wall of the tanks shall not be allowed.

    1. Each tank ladder shall be equipped with a ladder safety system in compliance with all OSHA requirements and to meet ANSI A14.3 design requirements. Ladder safety system shall include all necessary components to provide a fully operational system, including one (1) full body safety harness with a 310-lb. weight capacity for each ladder safety system. Ladder Safety Systems shall be Miller Vi-Go by Honeywell, LAD_SAF by DBI Sala, or approved equal.

M. The tank shall be provided with a minimum of three lifting lugs. Lifting lugs shall be capable of withstanding weight of an empty tank with a safety factor of 3 to 1. Tanks with capacities under 2,000 gallons do not require lifting lugs.

N. Each tank shall be provided with a restraint system with necessary cable assemblies, anchor clips / plates and anchor bolts. Restraint system shall withstand wind load or seismic load, whichever is greater, calculated in accordance with current IBC, CBC, and ASCE 7 code. Anchor clips / plates requiring holes through the side wall of the tanks shall not be allowed.

    1. The anchor clips / plates and cables shall be designed and supplied by the tank manufacturer. The tank manufacturer shall submit calculations, sealed by a

Professional Engineer, to verify that tie-down lugs and cables can withstand buoyancy, seismic activity, and wind load.

2. The anchor bolts, nuts, washers, shims and related hardware shall be sized and provided by the Contractor. The Contractor shall size the anchor bolt anchoring depth and edge distance for the tank pad. The Contractor shall submit calculations, sealed by a Professional Engineer, to verify that anchor bolts can withstand buoyancy, seismic activity, and wind load.

O. The tank shall be provided with a permanently attached label providing the following information:

1. Name, concentration, and specific gravity of material stored

2. Tank resin

3. Tank dimensions and capacity

4. Maximum temperature rating of tank

5. Manufacturer

6. Date of manufacture

P. All metallic parts, fasteners, brackets, mounting hardware, and accessories provided by the tank manufacturer shall be constructed of corrosion resistant metals as specified in Section 1.02.

2.04 PIPING SUPPORT

A. All horizontal sections of piping inside the containment area and trench shall be supported by thermoplastic pads at maximum 5-foot intervals as shown in the Drawings to prevent the piping from resting directly on concrete.

B. For vertical piping exterior to the tank, all pipe supports, hardware, accessories, etc., shall be provided for connections as shown in Section 1.02. Vertical piping into the tanks shall be supported every five feet and shall be parallel to the tank wall. External vertical piping shall be not less than 6 inches from the tank wall.

C. All piping into the tanks shall be supported such that no weight is placed on the tank or its connections.

2.05 ELECTRICAL AND CONTROL REQUIREMENTS

A. Where specified in Section 1.02, chemical storage tanks shall be provided with heating panels. Heat tracing system for temperature maintenance shall be designed to maintain a desired product temperature, not to exceed 100°F. Each system shall include tank heating pads and a temperature controller. The quantity and type of system shall be

determined by the size of the tank, the desired temperature maintenance and environmental conditions. Systems shall be available in 30, 60 or 100°F. Tanks shall be supplied with the heating panels and a controller installed by the tank manufacturer. Power supply shall be the only field installation required.

1. Pads to operate on 120 VAC single phase with a maximum power density of 0.5 watts/sq.inch.

2. Silicone pad heaters must fully comply with Article 427-23 (b) of the National Electric Code.

3. Temperature controller to be supplied with two electronic thermostats switching the heating system via one solid state relay. Primary thermostat to control desired product temperature and secondary thermostat to provide over temperature protection at 150°F.

PART 3 – EXECUTION

3.01 MANUFACTURER'S FIELD SERVICES

A. The services of a qualified manufacturer's technical representative shall be provided in accordance with Section 46 00 00 – Equipment General Provisions and shall include the following site visits for each series of tanks:

Service	Number of Trips	Number of Days/Trip
Inspection and Testing	1	1

3.02 INSTALLATION

A. The Contractor shall furnish and install the polyethylene storage tanks and related items in accordance with the manufacturers' recommendations and in accordance with Section 46 00 00 – Equipment General Provisions.

B. A manufacturer's field representative shall be on site when each tank is installed to observe installation and verify that each tank has been installed per manufacturer's recommendations. The manufacturer shall provide a report certifying that each tank has been installed properly.

C. All piping, valves, fittings, conduit, wiring, etc., required to interconnect system components shall be furnished and installed by the Contractor. Piping materials shall be as specified in Section 40 06 20 – Process Pipe, Valve and Gate Schedules.

D. All metallic fasteners, brackets, mounting hardware, and accessories located in chemical storage and feed areas shall be constructed of corrosion-resistant metals as specified in Section 1.02.

E. All tanks shall be mounted on concrete pads only when demonstrated to be fully cured. The finished surface of each tank bottom shall be sufficiently flat, smooth, and free of irregularities, to prevent the possibility of tank failure from point loads or other sources. Contractor shall coordinate with tank manufacturer for size and locations of notch in pad to accommodate outlet fittings.

F. The Contractor shall install 2 layers of EPDM or an appropriate number of layers or roofing felt, as recommended by the tank manufacturer, between each concrete pad and storage tank, if recommended by the tank manufacturer. The tanks shall be installed on level pads.

3.03 SHOP TESTING

A. Material Testing

1. Perform gel and low temperature impact tests in accordance with ASTM D 1998 on condition samples cut from each polyethylene chemical storage tank.

2. Degree of Crosslinking. Use Method C of ASTM D 1998- Section11.4 to determine the ortho-xylene insoluble fraction of cross-linked polyethylene gel test. Samples shall test at no less than 60 percent.

B. Tank Testing

1. Dimensions: Take exterior dimensions with the tank empty, in the vertical position. Outside diameter tolerance, including out-of-roundness, shall be per ASTM D 1998. Fitting placement tolerance shall be +/- 1/2-in vertical and +/- 1 degree radial.

2. Visual: Inspect for foreign inclusions, air bubbles, pimples, crazing, cracking, and delamination.

3. Hydrostatic test: Following fabrication, the bottom tanks, including inlet and outlet fittings, shall be hydraulically tested with water by filling to the top sidewall for a minimum of 1 hour and inspected for leaks. Following successful testing, the tank shall be emptied and cleaned prior to shipment.

3.04 FIELD TESTING

A. Field testing shall be performed in accordance with Section 46 00 00 – Equipment General Provisions.

B. Upon completion of installation of tank and prior to connecting piping, the Contractor shall provide blind flanges or other suitable plugs for all openings in the tanks, fill tanks with clean water provided by the Owner from a source approved by the Engineer and conduct a leakage test as specified herein. Tanks shall be filled up to the top of the straight shell of the tank and left to sit over a 5-day test period. There shall be no

leakage over the test period. Leakage around openings in the tanks shall be stopped by tightening nuts and bolts or replacing gaskets as required. Upon satisfactory completion of leakage test, Contractor shall drain the tanks and dispose of water in a suitable manner.

END OF SECTION

DIVISION 46 – WATER AND WASTEWATER EQUIPMENT

SECTION 46 00 00
EQUIPMENT GENERAL PROVISIONS

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish, install, test, and place in acceptable operation all mechanical equipment and all accessories as specified, as shown on the Drawings, and as required for a complete and operable system.

B. The mechanical equipment shall be provided complete with all accessories, special tools, spare parts, mountings, shims, sheaves, couplings, and other appurtenances as specified, and as may be required for a complete and operating installation.

C. The Contractor shall provide the Owner complete and operational equipment/systems. To this end, it is the responsibility of the Contractor to coordinate all interfaces related mechanical, structural, electrical, instrumentation, and control work and to provide necessary ancillary items such as controls, wiring, etc., to make each piece of equipment operational as shown and specified.

D. The complete installation shall be free from excessive vibration, cavitation, noise, oil leaks, and water leaks.

E. The requirements of this section shall apply to equipment furnished under Divisions 40, 43, and 46.

F. Comply with reference specifications, codes and standards as specifically modified, complimented, and supplemented herein.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. All equipment, materials, and installations shall conform to the requirements of the most recent editions with latest revisions, supplements, and amendments of the specifications, codes, and standards listed in Section 01 42 00 – References along with those identified herein this and other individual specification sections.

B. American Institute for Steel Construction (AISC)

C. American National Standards Institute/American Bearing Manufacturers Association (ANSI/ABMA):

1. ANSI/ABMA 9 – Load Ratings and Fatigue Life for Ball Bearings

2. ANSI/ABMA 11 – Load Ratings and Fatigue Life for Ball Bearings

05-23-2023

D. Acoustical Society of America (ASA) / American National Standard Institute (ANSI) S2.75, Shaft Alignment Methodology:

1. Part 1: General Principles, Methods, Practices, and Tolerances

2. Part 2: Vocabulary

3. Part 3: Alignment of Vertically Oriented Rotating Machinery

4. Guidelines and recommendations included in ASA/ANSI S2.75 shall establish and be interpreted as the minimum requirements for acceptance for leveling, grouting and alignment related work.

E. American National Standards Institute / American Society of Mechanical Engineers (ANSI/ASME) Standard B29.1, Heavy Duty Offset Sidebar Transmission Roller Chains and Sprocket Teeth.

F. American Welding Society (AWS):

1. D1.1 "Structural Welding Code - Steel"

2. D1.2 "Structural Welding Code - Aluminum" of the American Welding Society

G. Electrical Apparatus Service Association, Inc. (EASA) Mechanical Reference Handbook (latest revision).

H. Standard, ISO 1940 – Mechanical Vibration – Balance quality requirements for rotors balance quality grade for rotors in a constant rigid state.

I. In the event of conflict between individual specifications and reference specifications, codes and standards, the more restrictive criteria shall govern.

1.03 ACTION/INFORMATIONAL SUBMITTALS

A. Product Data:

1. Comply with Section 01 33 00 – Submittals Procedures

2. Fabrication information

B. Provide submittals identified in individual equipment specification sections in addition to the submittals identified herein.

C. Shop Drawings shall include the following information in addition to the requirements of Section 01 33 00 – Submittal Procedures and shall include the following additional information:

1. Equipment name, identification number and specification number.

2. Performance characteristics and descriptive data, including but not limited to capacity, power, speed, torque, and efficiency.

3. Detailed equipment dimensional drawings and setting plans including but not limited to:

    a. General cutaway sections

    b. Materials of construction

    c. Dimension of shaft projections

    d. Shaft and keyway dimensions

    e. Shaft diameter

    f. Shaft connection details

    g. Dimension between bearings

    h. General dimensions of equipment

    i. Anchor bolt locations

    j. Forces

    k. Assembly views

    l. Weights: Provide weight of entire equipment assembly, including motor and base weight of individual major subassemblies. Indicate the weight of each component, and total static and dynamic loads imparted by the equipment to the supporting structure.

    m. Rotating assembly technical information and illustration.

    n. Drawings shall identify each component by tag number to which the catalog data and detail sheets pertain.

    o. Drawings showing the location and type of all equipment, system components, supports, hangers, foundations and the required clearances to operate and maintain equipment, valves and system components in a code compliant, safe and ergonomic manner. Drawings shall show clearances reserved for walking access around all sides, for opening access doors fully, for visual inspection for condition monitoring, and for the performance of maintenance tasks including but not limited to changing filters, replacing belts, maintaining lubrication levels, predictive maintenance and performing diagnostic functions.

4. Drive and motor data as required by Division 26 – Electrical. Complete motor data shall include but not be limited to size, make, type and characteristics along with wiring diagrams. Where equipment and motor speeds are to be regulated by variable speed drives, the CONTRACTOR shall coordinate, furnish and exchange all necessary requirements with the respective equipment manufacturers to ensure compatibility and shall submit equipment, shafting, coupling, motor and variable speed drive shop drawings.

5. Bearings:

    a. Information on bearings including but not limited to: type, size, materials of construction.

    b. Bearing life calculations including but not limited to: basic dynamic load rating, static load rating, rating life, ABMA L10 reliability (expressed in hours of bearing life) and bearing system life.

6. Gear box design and performance criteria and AGMA service factor, including but not limited to the following:

    a. Thermal horsepower rating

    b. Bearing type

    c. Actual gear ratio

    d. Forced lubrication system: Provide description of equipment, system and instrumentation including but not limited to flow meter, pressure switches, etc.

    e. Gear tooth finish quality

7. Piping schematics.

8. Equipment protective device details and connection diagrams.

9. Panel layout drawings, schematic wiring diagrams, and component product data sheets for control panels.

10. A list of spare parts and special tools to be provided.

11. Information on equipment appurtenances including couplings, shaft guards, v-belt drive systems, etc.

12. All additional information required to demonstrate conformance with the equipment specifications.

13. Results of critical speed analyses, structural, lateral, and torsional dynamic analyses as required herein and in the individual specification sections.

14. Warranty documentation including statement of duration of warranty period, contact phone numbers, and contact addresses for warranty issues.

15. Shipment, delivery, handling, and storage instructions.

16. Installation instructions

17. Manufacturers literature and brochures

18. Materials of construction and associated specifications (such as AISI, ASTM, SAE, etc.), including grade and type.

19. Anchor design in accordance with Section 05 05 23 – Metal Fastening.

20. Intermediate shafting design, including but not limited to general arrangement drawings, engineering data, materials of construction, recommended angular offsets (for cardan universal jointed shafts), and shaft critical speed analyses (including 1st, 2nd and 3rd critical speed analysis).

21. Coatings: Coating system data and description of coating system, surface preparation and shop painting, including certification that the shop paint is compatible with the finish paint.

22. Pre-commissioning lubrication oil flushing plan developed by a machinery lubrication specialist, specifically for each piece of lubricated equipment. Plan shall identify, describe procedure and demonstrate data-based approach to demonstrating achievement of lubricant cleanliness via flushing. Level of lubricant cleanliness shall be as required by equipment manufacturer's written recommendations.

23. Equipment installation lists.

24. Equipment specific requirements for levelness, plumbness, flatness, coplanarity and coplanar surface deviation.

1.04 CLOSEOUT SUBMITTALS

A. Submit warranty documentation in compliance with:

1. Section 01 33 00 – Submittal Procedures

B. Operation and Maintenance (O&M) manuals shall be submitted in accordance with Section 01 33 00 – Submittal Procedures and Section 01 78 23 Operation and Maintenance Data.

1.05 MAINTENANCE MATERIALS SUBMITTALS

A. Operation and Maintenance (O&M) manuals shall be submitted in accordance with:

1. Section 01 33 00 – Submittal Procedures

2. Section 01 78 23 – Operation and Maintenance Data

B. Comply with Section 01 78 43 – Spare Parts and Extra Materials:

1. For spare parts, extra stock materials, and tools, submit quantity of items specified in associated Specification Section.

2. Submit complete list of spare parts, extra stock materials, maintenance supplies and special tools required for maintenance for one year with unit prices and source of supply. Indicate number/quantity specified and furnished, manufacturer, part number, and description.

C. Comply with Section 01 79 00 – Instructions to Owner's Personnel.

D. Lubrication Information:

1. Comply with Specification Section 01 78 23 – Operation and Maintenance Data.

2. Complete lubrication instructions and lubricant schedule, including manufacturer's recommended lubricant. All lubricants shall be food grade, NSF 61 approved. Schedule shall include frequency of lubricant application, type of lubricant, and instructions regarding lubricant application

1.06 QUALITY ASSURANCE SUBMITTALS

A. Factory testing plan.

B. Factory Test Results shall be submitted and approved prior to shipment of equipment.

C. Field testing plan.

D. Comply with Section 01 75 00 – Check Out and Start Up Procedures.

E. Alignment Report:

1. Alignment reports shall contain numerical values to express offset and angular alignment and all other parameters documented in ANSI/ASA S2.75.

2. Alignment reports shall be submitted immediately after each of the following activities have been completed:

a. Preliminary Alignment

b. Final Alignment (at both ambient and operating temperatures)

c. Re-check of alignment

F. Preliminary field test data

G. System field quality control testing

H. Final field test data

I. Certified test reports

1.07 GENERAL INFORMATION AND DESCRIPTION

A. All parts of the equipment furnished shall be designed and constructed for the maximum stresses occurring during fabrication, transportation, installation, testing, and all conditions of operation. All materials shall be new and shall conform to all applicable Sections of these Specifications.

B. All parts of duplicate equipment shall be interchangeable without modification. Manufacturer's design shall accommodate all the requirements of these Specifications.

C. Equipment and appurtenances shall be designed in conformity with specifications, codes and reference standards.

D. All bearings and moving parts shall be protected by bushings or other Engineer approved means against wear, and provision shall be made for accessible lubrication by extending lubrication lines and fittings to approximately 30 inches above finished floor elevation.

E. Details shall be designed for appearance as well as utility. Protruding members, joints, corners, gear covers, etc., shall be finished in appearance. All exposed welds on machinery shall be ground smooth and the corners of structural shapes shall be rounded or chamfered.

F. Machinery parts shall conform within allowable tolerances to the dimensions shown on the working drawings.

G. All machinery and equipment shall be safeguarded in accordance with the specifications, codes, and reference standards.

H. All rotating shafts, couplings, or other moving pieces of equipment shall be provided with protective guards of sheet metal or wire mesh, neatly and rigidly supported. Guards shall be removable as required to provide access for repairs.

I. All equipment or removable components greater than 100 pounds shall have lifting lugs, eyebolts, etc., for ease of lifting, without damage or undue stress exerted on its components.

J. All manufactured items provided under this Section shall be of current manufacture and shall be the products of manufacturers specializing in the manufacture of such products.

K. Code Compliance, safety and ergonomics for operating and maintenance personnel accessing equipment shall be considered during shop drawing development, fabrication, and installation. Items to considering include but are not limited to clearances reserved for walking access around all sides, for opening access doors fully, for visual inspection for condition monitoring, and for the performance of maintenance tasks including but not limited to changing filters, replacing belts, maintaining lubrication levels, predictive maintenance and performing diagnostic functions.

1.08 EQUIPMENT WARRANTIES

A. Warranty requirements shall be as specified in Section 01 61 00 – Product Requirements and Options and Section 01 75 00 – Checkout and Startup Procedures. Warranty requirements are supplementary to the individual equipment specifications.

1.09 DEFINITIONS

A. Comply with specification Section 01 42 00 – References.

B. Refer to the specified reference specifications, codes and standards for definitions applicable to this specification. Additional definitions are included hereafter.

C. Chockplate: A solid steel (or alloy steel) plate with a machined top surface that is grouted to a concrete foundation to support and maintain alignment of a machinery structural steel base plate.

D. Equipment Train: Two or more rotating equipment machinery elements consisting of at least one driver and one driven element joined together by a coupling.

E. Mounting plate: A device used to attach equipment to concrete foundations; includes base plates, soleplates, and chockplates. A mounting plate is a base-support mechanism for the attached machinery and all individual pieces of machinery are expected to be removable from the mounting plate as a single assembly.

F. Operating Temperature (Thermal) Alignment: A procedure to determine the actual change in relative shaft positions within a machinery train from the ambient (not running) condition and the normal operating temperature (running) condition by taking measurements from start-up to normal operating temperature while the machine(s) is (are) operating, or after the shafts have been stopped but the machines are still near operating temperature.

G. Preliminary alignment: The aligning of two adjacent machinery shafts to ensure that final alignment can be achieved without being bolt bound. This is accomplished before grouting (for horizontal machines) and the measurement of piping strain on the machinery.

H. Soleplate: A solid steel (or alloy steel) plate with a machined top surface that is grouted to a concrete foundation to support and maintain alignment of machinery.

PART 2 – PRODUCTS

2.01 GENERAL

A. All like components within a piece of equipment shall be provided by the same manufacturer.

B. Base plates:

1. Top surface of mounting plates shall be machined in locations where equipment supports/feet will contact the plate.

2. Equipment contact points shall be flat and parallel within ASA/ANSI 2.75 tolerances or 0.002-inches per foot, whichever is more stringent, and within related tolerances.

3. There shall be no paint where equipment supports or feet contact mounting plate.

4. Mounting plate shall be sufficiently rigid to avoid bending or flexing when equipment is installed.

2.02 ANCHORS AND SUPPORTS

A. Comply with the following Specification Sections:

1. Specification Section 05 05 23 – Metal Fastening.

2. Comply with individual equipment specifications.

B. The Contractor shall furnish, install, and protect all necessary guides, bearing plates, anchor and attachment bolts, and all other appurtenances required for the installation of the devices included in the equipment specified. Working Drawings for installation shall be furnished by the equipment manufacturer, and templates shall be used by the Contractor when required in the detailed equipment Specifications.

C. Anchor bolts and fasteners:

1. Anchor bolts shall be designed and provided by the Contractor in accordance with Section 05 05 23 – Metal Fastening, and with the individual equipment Specifications.

2. All anchor bolts shall have at least the minimum diameter as required by Specification Section 05 05 23 – Metal Fasteners.

3. All anchor bolts, guard bolts, washers, clips, clamps, fasteners, and leveling plate pads, nuts, shims, and jack bolts of any type shall be constructed of 316 stainless steel, unless otherwise specified the individual equipment Specifications.

4. Undercutting of anchors or fasteners shall not be permitted.

D. Pipe sleeves as a means for adjusting anchor bolts shall be provided where indicated in the contract documents or required by the equipment manufacturer.

E. The Contractor shall provide all concrete pads or pedestals required for equipment furnished. All concrete equipment pads shall be a minimum of 4-inches high, unless otherwise shown on the Drawings, and shall be doweled.

2.03 DEFAULT MATERIALS

A. Equipment shall be constructed out of the materials specified in respective individual pumping specification sections. Material not specifically called for shall be high-grade, standard commercial quality, free from all defects and imperfection that might affect the serviceability of the product for the purpose for which it is intended.

2.04 STRUCTURAL STEEL

A. Structural steel used for fabricating equipment shall conform to the requirements of Section 05 12 00 – Structural Steel.

B. All materials shall conform to applicable provisions of the AISC Specifications for the design and fabrication of structural steel, and to pertinent ASTM Standard Specifications.

2.05 DISSIMILAR METALS

A. All dissimilar metals shall be isolated in accordance with Section 05 10 00 – Metal Materials and to the satisfaction of the Engineer.

2.06 GALVANIZING

A. Where required by the equipment specifications, galvanizing shall be performed in accordance with Section 05 05 13 – Galvanizing.

2.07 STANDARDIZATION OF GREASE FITTINGS

A. The grease fittings on all mechanical equipment shall be such that they can be serviced with a single type of grease gun. Fittings shall be “Zerk” type.

2.08 ELECTRICAL REQUIREMENTS

A. All electrical equipment and appurtenances, including but not limited to motors, panels, conduit, and wiring, etc., specified in the equipment specifications shall comply with the

applicable requirements of the Division 26 specifications and the latest National Electric Code. Motor starters and controls shall be furnished and installed under Division 26 and Division 40 unless otherwise specified in the individual equipment specifications.

B. In the individual equipment specifications, specified motor horsepower is intended to be the minimum size motor to be provided. If a larger motor is required to meet the specified operating conditions and performance requirements, the Contractor shall furnish the larger sized motor and shall upgrade the electrical service (conduit, wires, starters, etc.) at no additional cost to the Owner.

C. Where variable frequency drives (VFDs) are specified, the Contractor shall be responsible for coordinating between equipment supplier and VFD supplier to ensure a complete and operational system. VFDs shall be furnished under Division 26 unless otherwise specified in the equipment specification. Wherever variable speed drives (VSDs) are specified the same requirements as for VFDs shall apply.

D. Motor starters and controls shall be furnished and installed under Division 26 and Division 40 unless otherwise specified in the individual equipment specifications.

2.09 ACCESSORIES, SPARE PARTS, AND SPECIAL TOOLS

A. Accessories, spare parts, and special tools shall be provided in accordance with Section 01 78 43 – Spare Parts and Extra Materials.

2.10 EQUIPMENT IDENTIFICATION

A. All mechanical equipment shall be provided with a substantial stainless steel nameplate, mechanically fastened with stainless steel hardware in a conspicuous place, and clearly inscribed with:

1. The manufacturer's name
2. Year of manufacture
3. Serial number
4. Principal rating data such as (for example):
    a. Capacity
    b. Pressure
    c. Horsepower
    d. Speed

B. Each piece of mechanical equipment shall also be identified as to name and number by a suitable laminated plastic or stainless steel nameplate mechanically fastened with

stainless steel hardware; for example, "Raw Water Pump #1 (RWP-1)". Coordinate name and number with same on remotely located controls, control panel, and other related equipment.

C. Nameplates shall not be painted over.

PART 3 – EXECUTION

3.01 SHOP TESTING

A. All equipment shall be tested in the shop of the manufacturer in a manner which shall conclusively prove that its characteristics comply fully with the requirements of the Contract Documents and that it will operate in the manner specified or implied.

B. No equipment shall be shipped to the project site until the Engineer has been furnished a certified copy of test results and has notified the Contractor, in writing, that the results of such tests are acceptable.

C. A certified copy of the manufacturer's actual test data and interpreted results thereof shall be forwarded to the Engineer for review.

D. If required by the individual equipment Specifications, arrangements shall be made for the Owner/Engineer to witness performance tests in the manufacturer's shop. The Engineer shall be notified ten working days before shop testing commences. Expenses are to be paid by Contractor.

E. Shop testing of electric motors shall conform to:

1. Section 26 05 60 – Low-Voltage Electric Motors

2. Section 26 05 00 – Basic Electrical Requirements

3.02 SHIPMENT, DELIVERY, HANDLING AND STORAGE

A. Shipment, delivery, and handling of equipment and materials shall be in accordance with Section 01 65 00 – Product Delivery Requirements.

B. Storage of equipment and materials shall be in accordance with Section 01 66 00 – Product Storage and Protection Requirements.

C. Shipping plans shall include consideration for protecting bearings and/or other rotating equipment from chatter damage.

D. Any equipment shipped to site that needs further attention shall have a WARNING tag affixed to it with indication of the action that should be taken in preparation for startup. Examples are: Final Lubrication, Mechanical Seal not in final position, etc.

3.03 MANUFACTURER'S FIELD SERVICES

A. Manufacturer's field services shall be in accordance with Section 01 75 00 – Checkout and Startup Procedures.

B. The Contractor shall arrange for a qualified factory trained Technical Representative from each manufacturer or supplier of equipment who is regularly involved in the inspection, installation, start-up, troubleshooting, testing, maintenance, and operation of the specified equipment. Qualification of the Technical Representative shall be appropriate to the type of equipment furnished and subject to the approval of the Engineer and the Owner. Where equipment furnished has significant process complexity, furnish the services of engineering personnel knowledgeable in the process involved and the function of the equipment. When necessary, the Contractor shall schedule multiple Technical Representatives to be present at the same time for the purpose of coordinating the operation of multiple pieces of related equipment.

C. Services of the Technical Representative will require a minimum of two site visits, one for installation and testing and one for startup and training, and will be for the minimum number of days recommended by the manufacturer and approved by the Engineer but will not be less than the number of days specified in individual equipment sections. Additional site visits may be required as described below and in the equipment specifications.

D. For each site visit, the Technical Representative shall submit jointly to the Owner, the Engineer, and the Contractor a complete signed report of the results of their inspection, operation, adjustments, and testing. The report shall include detailed descriptions of the points inspected, tests and adjustments made, quantitative results obtained if such are specified.

E. The manufacturer's Technical Representative shall provide the following services.

1. Installation: The Technical Representative shall inspect the installed equipment to verify that installation is in accordance with the manufacturer's requirements. Where required by individual equipment specifications, the Technical Representative shall also supervise the installation of the equipment.

2. Testing: After installation of the equipment has been completed and the equipment is presumably ready for operation, but before it is operated by others, the Technical Representative shall inspect, operate, test, and adjust the equipment as required to prove that the equipment is in proper condition for satisfactory operation under the conditions specified. Unless otherwise noted in the signed site visit report, the report shall constitute a certification that the equipment conforms to the requirements of the Contract and is ready for startup and that nothing in the installation will render the manufacturer's warranty null and void. The report shall include date of final acceptance field test, as well as a listing of all persons present during tests.

3. Startup: The Technical Representative shall start up the equipment for actual service with the help of the Contractor. If equipment or installation problems are experienced, the Contractor and the representative shall provide the necessary services until the equipment is operating satisfactorily and performing according to the specifications at no additional cost to the Owner. Unless otherwise noted in the signed site visit report, the report shall constitute a certification that the equipment conforms to the requirements of the Contract and is ready for permanent operation and that nothing in the installation will render the manufacturer's warranty null and void.

4. Training: Training shall be provided in accordance with Section 01 79 00 – Instruction of Owner Personnel.

5. Services after Startup: Where required by the individual equipment specifications, the Technical Representative shall return to the project site 30 days after the startup date to review the equipment performance, correct any equipment problems, and conduct operation and maintenance classes as required by the Owner. This follow-up trip is required in addition to the specified services of Technical Representative prior to and during equipment startup. At this time, if there are no equipment problems, each manufacturer shall certify to the Owner in writing that their equipment is fully operational and capable of meeting operating requirements. If the equipment is operating incorrectly, the Technical Representative will make no certification to the Owner until the problems are corrected and the equipment demonstrates a successful 30 days operating period.

F. The Contract amount shall include the cost of furnishing the Technical Representative for the minimum number of days specified, and any additional time required to achieve successful installation and operation. The times specified for services by the Technical Representative in the equipment Specifications are exclusive of travel time to and from the facility and shall not be construed as to relieve the manufacturer of any additional visits to provide sufficient service to place the equipment in satisfactory operation.

G. The Contractor shall notify the Engineer at least 14 days in advance of each equipment test or Owner training session.

H. The Technical Representative shall sign in and out at the office of the Engineer's Resident Project Representative on each day the Technical Representative is at the project.

3.04 INSTALLATION

A. The Contractor shall obtain written installation manuals from the equipment manufacturer prior to installation. Equipment shall be installed strictly in accordance with recommendations of the manufacturer. A copy of all installation instructions shall be furnished to the Engineer's field representative at least one week prior to installation.

B. The Owner's field representative (e.g., the Engineer or similar) shall witness all activities involved with equipment installation.

C. The Contractor shall have on hand personnel, construction equipment, and machinery of capacity to facilitate the work and to handle all emergencies encountered in work of this character. To minimize field erection problems, mechanical units shall be factory assembled insofar as practical.

D. Equipment shall be erected in a neat and workmanlike manner on the foundations at the locations and elevations shown on the Drawings.

E. All equipment sections and loose items shall be match-marked prior to shipping.

F. The Contractor shall furnish oil and grease for initial operation and testing. The manufacturer and grades of oil and grease shall be in accordance with the recommendations of the equipment manufacturer.

G. Leveling and Grouting:

1. Set equipment to dimensions shown on drawings. Dimensions shall be accurate to +/- 1/16 inch except as otherwise specified, required or indicated on the drawings.

2. Base plate Surface Preparation – Prior to setting equipment and grouting, inspect and clean equipment mounting base plates, pads, feet, and frames to remove all grease, rust, paint, and dirt.

3. Wedges (i.e., tapered shims) shall not be used for leveling, aligning, or supporting equipment.

4. General Equipment Leveling:

a. Non-rotating Equipment: Set level to +/- 1/16 inch per 10-foot length (0.005 inch per foot) unless manufacturer's requirements are more stringent.

b. Rotating Equipment: Install, set to the most stringent of the following requirements for levelness, plumbness, flatness, coplanarity and coplanar surface deviation:

1) ASA-ANSI S2.75, Shaft Alignment Methodology. Comply with tolerance ranges scheduled at the end of this specification section.

2) Individual equipment specifications

3) Manufacturer's pre-printed written requirements.

4) When the equipment manufacturer's pre-printed tolerances are more stringent than those stated in ASA/ANSI 2.75 or more stringent than the individual pump specification, the cost of field machining sole

plates or precision grouting sole plates shall be covered by the Contractor.

c. Shims or leveling nuts shall be used unless equipment is furnished with leveling feet. Set shims flush with equipment base plate edges. When grouting is required, equipment shall be shimmed to allow a minimum of one-inch grout thickness. Grout shall cover shims at least 3 inches. Final level check shall be held for inspection and approval by Engineer before proceeding.

d. Equipment shall be leveled by first using sitting nuts on the anchor bolts, and then filling the space between the equipment base and concrete pedestal with epoxy base plate grout, unless alternate methods are recommended by the manufacturer and are acceptable to the Engineer (e.g., such as shim leveling pumps, or chemical grout).

5. Grouting

a. Comply with Section 03 60 00 – Grout.

b. Grout Materials:

1) Rotating Equipment: Grout for rotating equipment shall be epoxy base plate grout. Cementitious grouts shall not be accepted for rotating equipment.

2) Non-rotating Equipment: Grout shall be as per the non-rotating equipment manufacturer's pre-printed written installation instructions and shall be subject to the Engineer's approval.

c. Fill pipe sleeves with grout, after bolt alignment is proven, and prior to placing grout under equipment bases.

d. Concrete Surface Preparation: Roughen concrete equipment pad surface by chipping, removing laitance, and unsound concrete. Clean area of all foreign material such as oil, grease, and scale.

1) When grouting with cementious grouts is approved, the contact area of the concrete equipment pad shall be saturated with water at least 4 hours prior to grouting, removing excess water ponds.

e. Application:

1) Place grout after the equipment base has been set and its initial alignment and level have been approved.

2) Form around the base, mix grout, and place in accordance with the grout manufacturers published instructions.

3) Grout mixture shall be flowable. Dry packing of grout shall not be permitted.

4) Eliminate all air or water pockets beneath the base using a drag chain or rope.

5) Grout voids detectable by tapping the top of the base plate with a hammer shall be grounds for removal and reinstallation of the work.

f. Finishing: Point the edges of the grout to form a smooth 45-degree slope.

g. After cementious grout has cured (not before 3 days after placement) paint exposed surfaces of grout with shellac.

h. Level Verification. After grout has cured, and immediately prior to final drive alignment, recheck equipment for level and plumb. Re-level and square as necessary. Hold final checks for inspection and approval by Engineer.

6. Inspect for and remove all machining burrs or thread pulls in female holes on mating surfaces of mounting frame and machine feet.

3.05 FIELD TESTING

A. Field testing shall be in accordance with Section 01 75 00 – Checkout and Startup Procedures.

B. All equipment shall be set, aligned, and assembled in conformance with the manufacturer's drawings and instructions. Provide all necessary calibrated instruments to execute performance tests. Submit report certified by the pump manufacturer’s representative.

C. Preliminary Field Tests, Yellow Tag.

1. As soon as conditions permit, after the equipment has been secured in its permanent position, the Contractor shall:

a. Verify that the equipment is free from defects.

b. Check for alignment as specified herein.

c. Check for direction of rotation.

d. Check motor for no load current draw.

2. Contractor shall flush all bearings, gear housings, etc., in accordance with the pre-commissioning lubrication oil flushing plan and manufacturer's pre-printed written recommendations, to remove any foreign matter accumulated during shipment, storage or erection. Lubricants shall be added as required by the manufacturer's instructions.

3. When the Contractor has demonstrated to the Engineer that the equipment is ready for operation, a yellow tag will be issued. The tag will be signed by the Engineer, or the Engineer's assigned representative and attached to the equipment. The tag shall not be removed.

4. Preliminary field tests, yellow tag, must be completed before equipment is subjected to final field tests, blue tag.

D. Final Field Tests, Blue Tag

1. Upon completion of the above, and at a time approved by the Engineer, the equipment will be tested by operating it as a unit with all related piping, ducting, electrical and controls, and other ancillary facilities.

2. The equipment will be placed in continuous operation as prescribed or required and witnessed by the Engineer or the Engineer's assigned representative and the Owner or the Owner's assigned representative.

3. The tests shall prove that the equipment and appurtenances are properly installed, meet their operating cycles and are free from defects such as overheating, overloading, and undue vibration and noise. Operating field tests shall consist of the following:

a. Check equipment for excessive vibration and noise.

b. Check motor current draw under load conditions. The rated motor nameplate current shall not be exceeded. The rated motor nameplate horsepower shall not be exceeded when a torque transducer is provided.

c. Recheck alignment where applicable, after unit has run under load for a minimum of 24 hours.

E. Additional field testing recommended by the manufacturer shall be performed at no cost to Owner.

F. Until final field tests are acceptable to the Engineer, the Contractor shall make all necessary changes, readjustments, and replacements at no additional cost to the Owner.

G. Upon acceptance of the field tests, a blue tag will be issued. The tag will be signed by the Engineer and attached to the unit. The tag shall not be removed, and no further

construction work will be performed on the unit, except as required during start-up operations and directed by the Engineer.

H. Defects which cannot be corrected by installation adjustments will be sufficient grounds for rejection of any equipment.

I. All costs in connection with field testing of equipment such as lubricants, temporary instruments, labor, equipment, etc., shall be borne by the Contractor. Power, fuel, chemicals, water, etc. normally consumed by specific equipment shall be supplied by the Owner unless otherwise specified in the individual equipment specifications.

J. The Contractor shall be fully responsible for the proper operation of equipment during tests and instruction periods and shall neither have nor make any claim for damage which may occur to equipment prior to the time when the Owner formally takes over the operation thereof.

K. Field testing of electric motors shall be in accordance with Section 26 05 60 – Low-Voltage Electric Motors and Section 26 05 00, Basic Electrical Requirements.

3.06 VIBRATION TESTING

A. Vibration testing shall be in accordance with Section 01 75 00 – Checkout and Startup Procedures.

3.07 FAILURE OF EQUIPMENT TO PERFORM

A. Any defects in the equipment, or failure to meet the guarantees or performance requirements of the Specifications shall be promptly corrected by the Contractor by replacements or otherwise.

B. If the Contractor fails to make these corrections, or if the improved equipment shall fail again to meet the guarantees or specified requirements, the Owner, notwithstanding their having made partial payment for work and materials which have entered into the manufacture of said equipment, may reject said equipment and order the Contractor to remove it from the premises at the Contractor's expense.

C. The Contractor shall then obtain specified equipment to meet the contract requirements or upon mutual agreement with the Owner, adjust the contract price to reflect not supplying the specific equipment item.

D. In case the Owner rejects said equipment, then the Contractor hereby agrees to repay to the Owner all sums of money paid to him for said rejected equipment on progress certificates or otherwise on account of the lump sum prices herein specified.

E. Upon receipt of said sums of money, the Owner will execute and deliver to the Contractor a bill of sale of all rights, title, and interest in and to said rejected equipment;

provided, however, that said equipment shall not be removed from the premises until the Owner obtains from other sources other equipment to take the place of that rejected.

F. Said bill of sale shall not abrogate Owner's right to recover damages for delays, losses, or other conditions arising out of the basic contract.

3.08 PAINTING

A. The equipment and motor shall be painted. All surface preparation, shop painting, field repairs, finish painting, and other pertinent detailed painting specifications shall conform to applicable paragraphs of Section 09 90 00 – Painting.

B. All shop coatings shall be compatible with proposed field coatings.

C. All inaccessible surfaces of the equipment, which normally require painting, shall be finished painted by the manufacturer.

D. Gears, bearing surfaces, and other unpainted surfaces shall be protected prior to shipment by a heavy covering of rust-preventive compound sprayed or hand applied which shall be maintained until the equipment is placed in operation. This coating shall be easily removable by a solvent.

3.09 WELDING

A. The Equipment Manufacturer's shop welding procedures, welders, and welding operators shall be qualified and certified in accordance with the requirement of AWS D1.1 "Structural Welding Code - Steel" or AWS D1.2 "Structural Welding Code - Aluminum" of the American Welding Society, as applicable.

B. The Contractor's welding procedures, welders, and welding operators shall be qualified and certified in accordance with the requirements of AWS D1.1 "Structural Welding Code - Steel" or AWS D1.2 "Structural Welding Code - Aluminum" of the American Welding Society, as applicable.

C. The Contractor shall perform all field welding in conformance with the information shown on the Equipment Manufacturer's drawings regarding location, type, size, and length of all welds in accordance with "Standard Welding Symbols" AWS A2.0 of the American Welding Society, and special conditions, as shown by notes and details.

Schedule 46 00 00 – 01 – Applicable Tolerance Range

Equipment Horsepower	ANSI/ASA S2.75 Quality Grade Tolerance Range
<= 25 HP	Minimal
> 25 HP < 100 HP	Standard
>= 100 HP	Precision

Schedule 46 00 00 – 01 – Applicable Tolerance Range

Equipment Horsepower	ANSI/ASA S2.75 Quality Grade Tolerance Range

Scheduled ANSI/ASA S2.75 Quality grade tolerance range categories relate to ANSI/ASA S2.75 quantified tolerances for: levelness, plumbness, flatness, coplanarity, coplanar surface deviation, shaft runout, shaft-to-shaft alignment, flex plane offset, angularity, and offset per tolerance plane separation.

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SECTION 46 33 42
MECHANICAL DIAPHRAGM METERING PUMPS

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish, install, adjust, and place in satisfactory operation positive displacement mechanically actuated diaphragm-type pumps as part of a complete packaged metering pump skid for chemical metering as specified herein and as shown on the Drawings. All mechanically actuated diaphragm-type chemical metering pump systems including pumps, piping, valves, chemical containment skids, and related appurtenances mounted on the skid shall be supplied by the same manufacturer. The manufacturer shall have sole responsibility for the satisfactory manufacture and performance of the system.

B. The chemical feed system as provided by the pump manufacturer shall contain the following items:

1. Skid with drip lip
2. Metering pumps with adjustable stroke length adjustment, gear reducer, motor, control panel / integral variable frequency drive
3. Calibration column
4. Pulsation dampeners installed inline within 18 inches of the pump discharge
5. Pressure gauges with diaphragm seals
6. Ball valves
7. Pressure relief valves
8. Backpressure valves
9. All piping, valves, gaskets, supports, hardware, wiring, and accessories necessary for a fully functioning skid as specified herein and as indicated on the Drawings.

C. The complete installation shall be free from excessive vibration, cavitation, noise, and oil or water leaks.

D. Equipment shall be provided in accordance with the requirements of Section 46 00 00 – Equipment General Provisions.

12-18-2024

1.02 OPERATING CONDITIONS AND PERFORMANCE REQUIREMENTS

A. Pumps and pump components shall be suitable for use in the chemical service specified herein. The equipment manufacturer is responsible for the coordination and selection of corrosion resistant materials for the chemical solutions specified herein and shall guarantee the suitability of the materials used in manufacturing the equipment.

B. Chemical Properties

	Sodium Hypochlorite
Concentration	12.5 Trade %
Specific Gravity	1.17 @ 68°F
pH	11.5 – 13
Freezing Point	-4- 5 °F
Viscosity	1.7 cPs @ 68°F
Vapor Pressure	12 - 17.5 mm Hg @ 68°F

C. Pump Performance Requirements

Chemical Pumped	**12.5% NaOCl**	**12.5% NaOCl**	**12.5% NaOCl**	**12.5% NaOCl**	**12.5% NaOCl**	**12.5% NaOCl**
No. of Units	1	1	2	2	2	2
No. of Spare Units	1	1	-	-	-	-
Pump ID	MP-56009	MP-56011	MP-56015, MP-56615	MP-56016, MP-56616	MP-56012, MP56612	MP-56010, MP-56610
Application Point	RAS Lines 2-5	Headworks Bar Screen Pre-chlorination	Outfall Pump Station	Reuse CCT	NPW CCT	Headworks Odor Control
Pump Rated Feed Rate	93.3 gph	93.3 gph	275 gph	11.1 gph	11.1 gph	93.3 gph
Pump Rated Discharge Pressure	58 psig	58 psig	58 psig	145 psig	145 psig	58 psig
Suction and Discharge Connections	SKT	SKT	SKT	SKT	SKT	SKT
Maximum Motor Speed	60 Hz	60 Hz	60 Hz	60 Hz	60 Hz	60 Hz
Motor Horsepower	1/3 HP	1/3 HP	3/4 HP	1/8 HP	1/8 HP	1/8 HP
Drive Type	AC Inverter Variable Speed	AC Inverter Variable Speed	AC Inverter Variable Speed	AC Inverter Variable Speed	AC Inverter Variable Speed	AC Inverter Variable Speed

1.03 SUBMITTALS

A. The following items shall be submitted with the Shop Drawings in accordance with, or in addition to the submittal requirements specified in Section 01 33 00 – Submittal Procedures and Section 46 00 00 – Equipment General Provisions:

1. A pump characteristic performance curve showing flow rate as a function of stroke length, stroke frequency, and pressure

2. Details on materials of construction of all components including applicable ASTM designations

3. Chemical resistance data for all wetted parts of pumps and accessories.

4. The total uncrated weight of the equipment plus the approximate weight of shipped materials. Support locations and loads that will be transmitted to bases and foundations. Exact size, placement, and embedment requirements of all anchor bolts.

5. Dimensional drawings, including recommended location of anchor bolts

6. Recommended location and mounting of pulsation dampening devices

7. Panel layout drawings, schematic wiring diagrams, and component product data sheets for control panels

8. Motor data sheet indicating motor horsepower; enclosure type; voltage; insulation class; temperature rise tests; service-rating; rotative speed; motor speed-torque relationship; efficiency and power factor at ½, ¾, and full load; running, full load, and locked rotor current values; and safe running time-current curves

9. Equipment and motor protective device details. Connection diagrams for motor and all protective devices.

10. Complete wiring diagrams

11. Complete control descriptions for pump operation

12. Complete erection, installation, and adjustment instructions and recommendations

13. Warranty documentation including statement of duration of warranty period and contact phone numbers and addresses for warranty issues

14. Complete lubricant schedule, including manufacturers of recommended lubricant and a cross reference table of alternative lubricant manufacturers and brand names for each lubricant recommended. Schedule shall include frequency of lubricant application, type of lubricant, and comments / remarks regarding lubricant application.

B. Shop drawings shall include all pumps and accessories and shall be submitted as a complete system. Partial submittals will be unacceptable.

1.04 WARRANTY

A. Warranty and Guarantee shall be as specified in Section 46 00 00 – Equipment General Provisions with the exception that a two (2) year factory warranty shall be provided on the Chemical-Feed Skids and Pumps from the date manufacturer's authorized service provider completes commissioning services.

1.05 MAINTENANCE AGREEMENT

A. A two (2) year maintenance agreement for the pump skids furnished and installed under this section, to be performed by the pump skid's local factory-trained service provider, shall be included with the purchase of the skid and shall include the following:

1. Alternating 6-Month and 12-Month Preventative Maintenance (PM) shall be performed by the manufacturer's authorized representative on Chemical-Feed Skids.

2. 6-Month PM service shall include retightening and tuning the skid to ensure optimum performance and that leaks are prevented or mitigated in a timely manner.

3. 12-Month PM services shall include 6-Month PM services plus changeout of all soft goods (diaphragms, ball checks, etc.) related to pumps and accessories.

4. Cycle shall repeat during the second year of operation with one more 6 Month and 12-Month PM services as described in paragraphs 2. and 3. above.

5. Additional on-demand quarterly service visits shall be included in agreement to address any issues that arise in between scheduled PM visits.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. The Manufacturer shall be a company specializing in manufacture, assembly, and field performance of positive displacement, motor driven, mechanically actuated diaphragm metering pumps. Manufacturer of pumps must have at least 20 operating installations in domestic water or wastewater treatment plants located in the United States over a period of at least seven years pumping the same fluid as specified.

B. Mechanical diaphragm-type metering pumps with integral controls shall be Sigma Control Series as manufactured by ProMinent, or Engineer / Owner pre-approved equal.

2.02 GENERAL

A. The pump supplier is responsible for the coordination of corrosion- and abrasion-resistant materials for the chemical solutions specified. The manufacturer shall include all features as necessary for satisfactory operation of the pumping systems for chemical solutions specified. All pumps shall be capable of handling the designated process fluids in their full commercial strengths. Pumps, motors and accessories shall be non-metallic or shall be coated with a heavy-duty protective epoxy coating resistant to the specified chemicals to prevent corrosion.

2.03 MECHANICAL DIAPHRAGM METERING PUMPS

A. The chemical metering pump(s) shall be microprocessor-controlled, motor-driven, reciprocating, mechanically actuated diaphragm type. The pump shall include a motor, oil-lubricated or permanently greased bearings, gear reducer and cam-and-spring drive mounted an aluminum housing. Such housing is to be sealed into an outer plastic housing for corrosion protection.

B. All pumping functions shall be set by membrane switch keypad and click wheel, and status shall be displayed on an illuminated LCD. The keypad shall allow for simple scrolling and display of programmed parameters.

C. The pump shall be fully tested by the manufacturer prior to shipment to meet rated flow and pressure.

D. The pump shall have a universal power supply that allows it to operate at a supply voltage in the range of 100-230 VAC +/-10%, 50-60Hz, single phase.

E. The diaphragm shall be constructed of a solid core, vulcanized into nylon-reinforced EPDM, with a PTFE-faced fluid contact surface. The diaphragm shall have a convex design fitting into a concave liquid end to minimize dead volume and promote the flow of solids in suspension. The pump shall also have a diaphragm failure detector with a visible indicator of a diaphragm rupture. Fault indication and pump shut down shall be provided in the case of a diaphragm rupture.

F. The liquid end shall be physically separated from the drive unit by a back plate with weep hole creating an air gap. An elastomer shaft wiper seal shall prevent contamination of the drive if the primary diaphragm fails.

G. The liquid end shall be virgin PVDF as indicated below.

	RAS 2-5 Service	**Influent Pre-chlorination Service**	**Outfall Pump Station Service**	**Reuse CCT Service**	**NPW CCT Service**	**Headworks Odor Control Service**
Pump Liquid End	PVDF with ceramic valve balls	PVDF with ceramic valve balls	PVDF with ceramic valve balls	PVDF with ceramic valve balls	PVDF with ceramic valve balls	PVDF with ceramic valve balls

H. Stroke length control shall be adjustable manually by means of a stroke length knob, in increments of 1%, from 0% to 100% of stroke length. Stroke length shall be determined by a sensor within the stroke adjustment knob that provides accurate feedback to the electronics of the pump for calibration and LCD display of stroke length. The digital display and optional analog output will calculate, display, and transmit the flow of the pump based on pump speed and stroke length settings.

I. Stroke frequency control for this metering pump shall be accomplished through microprocessor control with proportional start/stop of the motor, from 0% to 33% of stroke rate. Stroke rate shall be accomplished through variable speed of the motor from 34% to 100% of stroke rate. Control shall be switchable between manual or external control. In manual mode, stroke frequency control shall be manually adjusted by the P-16 digital process controller for each pump for local 4-20mA control of the pump when the control panel is in local mode. In external mode, the pump shall be capable of receiving a 4-20 mA input via an external control cable. The metering pump shall be capable of remote ON-OFF operation using the PAUSE function via a voltage-free contact relay through an optional control cable. The pump shall include a TEFC, four-pole AC motor.

J. It shall be possible to selectively slow the discharge or the suction stroke speed of the pump to accommodate application requirements and process fluid viscosity and off-gassing conditions.

K. The pump shall be equipped with an output relay which shall be programmable for any of the following indications:

    1. Fault Indication

    2. Fault Indication and pacing relay

    3. mA Output - The current output signal indicates the pump's actual calculated metering volume.

L. For simplified operator monitoring, the pump shall be equipped with a three LED Display (Red, Yellow, and Green) to locally indicate normal operation, fault conditions, and warning conditions.

M. Operating Modes – The pump shall have the following operating modes available:

    1. Manual operating mode permitting the operation of the pump stroke and speed controls manually.

    2. Contact operating mode providing the option of controlling the pump externally by means of potential-free contacts (e.g. by means of a contact water meter). The number of pump strokes per input contact can be scaled by a factor ranging from 0.01 to 99.99 to tailor the pump feed rate to the application.

3. Batch operating mode providing the option of working with large factors (up to 99,999). Metering can be triggered either by pressing the Click wheel or by a pulse received via the "External control" terminal or through a contact or a semiconductor switching element. It is possible to pre-select a metering volume (batch) or a number of strokes using the Click wheel in the Settings menu.

4. The Analog operating mode allows the capacity and/or stroke rate to be controlled via an analog (4-20mA) current signal via the "External control" socket. The processing of the current signal can be preselected via the control unit.

2.04 PUMP ACCESSORIES

A. The metering pump supplier shall furnish accessory equipment as specified herein and as shown on the Drawings including but not limited to the following:

Chemical	Accessory Equipment	Pressure Range / Setting	Material(s)	Connections
12.5% NaOCl	Pressure Gauge	Range: 0 – 160 psi	Tube and Process Connection: 316L SS Fill Liquid: Halocarbon	Threaded
12.5% NaOCl	Diaphragm Seal for Pressure Gauge	N/A	Diaphragm: PTFE or Viton Top Housing: Titanium Bottom Housing: Titanium, PVC, PVDF] Fill Fluid: Halocarbon	Instrument: Threaded Process: Threaded
12.5% NaOCl	Pressure Relief Valve	Range: 5 – 160 psi Initial Setpoint: 53 psi	Body: PVC with Noryl top Diaphragm: Viton,	Socket
12.5% NaOCl	Backpressure / Anti-siphon Valve	Range: 5 – 160 psi Initial Setpoint: 53 psi	Body: PVC with Noryl top Diaphragm: Viton	Socket
12.5% NaOCl	Pulsation Dampeners and Suction Accumulators	Range: 0 – 100 psi	Body: PVC Bladder and Bellows: Viton	Socket
12.5% NaOCl	Calibration Column	N/A	Body: Clear PVC End Cap: PVC	Socket

1. Pressure gauges shall be provided on the discharge of metering pumps as shown on the Drawings. Gauges shall be as specified in Section 40 73 13 – Pressure and Differential Pressure Gauges. Gauges shall be liquid-filled, and pressure snubbers

shall not be required. Each gauge shall have a range as detailed in the table above. Each gauge shall be provided with a diaphragm seal as specified in Section 40 79 00 – Miscellaneous Instruments, Valves, and Fittings, constructed of materials as detailed in the table above or as recommended by the pump manufacturer. Each pressure gauge shall also be provided with an isolation valve constructed of materials that are resistant to the chemical applications.

2. Pressure relief valves shall be supplied by the pump manufacturer in the quantities and locations as shown on the Drawings. Valve body, diaphragm materials, and connections shall be as detailed in the table above or as recommended by the pump manufacturer for chemical compatibility and operating pressure. Valve shall be flow-through or three-port as shown on the Drawings. Pressure range and initial setpoint shall be as detailed in the table above. Sizing of the valve shall be the responsibility of the pump manufacturer. Pressure relief valves shall be manufactured by the pump manufacturer, Blacoh Fluid Control, Plast-o-Matic, or equal.

3. Backpressure / anti-siphon valves shall be supplied by the pump manufacturer in the quantities and locations as shown on the Drawings. Valve body, diaphragm materials, and connections shall be as detailed in the table above or as recommended by the pump manufacturer as required for chemical compatibility and operating pressure. Pressure range and initial setpoint shall be as detailed in the table above. Sizing of the valve shall be the responsibility of the pump manufacturer. Valves shall be capable of functioning as specified with downstream discharge pressure as detailed in Section 1.02.C. Backpressure / anti-siphon valves shall be manufactured by the pump manufacturer, Blacoh Fluid Control, Plast-o-Matic, or equal.

4. Pulsation dampeners and suction accumulators shall be supplied by the pump manufacturer in the quantities and locations as shown on the Drawings and as recommended by the pump manufacturer based on the system operating conditions. Pulsation dampener body, bladder, and bellows materials, and connections shall be as detailed in the table above or as recommended by the pump manufacturer as required for chemical compatibility and operating pressure. The pump manufacturer shall size the dampener to remove a minimum of 90% of the pulsation from the metering pump. Dampeners shall be provided with a pressure gauge with an operating range as detailed in the table above and a charging valve. Pulsation dampeners and suction accumulators shall be manufactured by the pump manufacturer, Blacoh Fluid Control, Plast-O-Matic, or equal.

5. Calibration columns shall be supplied by the pump manufacturer in the quantities and locations as shown on the Drawings. Calibration column materials and connections shall be as detailed in the table above or as recommended by the pump manufacturer as required for chemical compatibility. Calibration column shall be provided with a top cap for connection to a vent / return line. Graduations shall

be in mL and gallons per hour. Each calibration column shall be sized such that at 50% pump capacity, the calibration column will be emptied in 60 to 90 seconds. Calibration columns shall be manufactured by the pump manufacturer, Blacoh Fluid Control, Plast-o-Matic, or equal.

B. Piping on the suction and discharge of each metering pump shall be as specified in the Piping System Schedule at the end of Section 40 06 20 – Process Pipe, Valve, and Gate Schedules. Materials of construction shall be completely compatible with the specified chemical. Contractor shall provide transition fittings for metal pipe connected to PVC accessories or for PVC pipe connected to metal accessories.

2.05 SKID-MOUNTED FEED SYSTEMS

A. Each chemical feed system shall be completely assembled, mounted, calibrated, tested, and delivered to the site on a single skid. Components to be mounted on the skid are as indicated on the Drawings and shall include the metering pumps; piping and valves; pump accessories as specified and shown on the drawings; and wiring, electrical interface boxes, and receptacles integral to the skid. The chemical metering pump manufacturer shall be responsible for providing all equipment, valves and piping within the skid boundary.

B. Each skid shall be provided with its own local control panel. Local disconnect is provided by duplex receptacle with weatherproof cover mounted on the skid properly. Enclosures shall be NEMA 4X FRP construction. The pump control panels shall provide all the functions and interfaces as shown on the specification P&ID’s, including but not limited to the following features: main circuit breaker and branch circuit breakers as needed.

C. The skids shall be constructed of fusion welded black polypropylene sheets with a minimum thickness of ½”. The design of the skid shall include gussets and supports as required for all components and shall be self-supporting. The skid shall be designed with a minimum of a 2-1/2" containment lip to contain spills. Forklift truck cut outs shall also be provided. The skid shall be manufactured using continuous welding technology; bolted construction is not acceptable. Pump stands shall be provided to elevate the metering pumps above the skid base.

D. Skid system piping and valves shall be provided as specified in Division 40 – Process Interconnections and a shown on the Drawings. Piping shall include isolation valves and unions for all serviceable components. The pump connections shall be designed with replaceable pipe sections on the suction and discharge via union or flange so that pump replacement or upgrade can be accomplished without cutting into skid piping. Flexible tubing connections and quick connects shall be provided between fixed piping and suction and discharge of the pumps.

E. Each pump shall have the following devices mounted on the door of the control panel for operator interface: Local-Off-Remote (L-O-R) Illuminated selector indicating running status, Pump general alarm light, Local speed control digital potentiometer, actual speed

indication when pump is provided with analog output option. Each pump shall have the following signals available for the plant SCADA / PLC via hard wire connection: Pump running status, pump alarm status, pump speed analog feedback (optional when provided), remote mode selected status. Each pump shall accept the following signals from the plant SCADA / PLC via hard wire connection: Dry contact pump run command, Analog 4-20mA speed command.

F. All components shall be UL listed or recognized, door mounted devices shall be NEMA 4x, 22mm, Heavy Duty, Oil Tight, and instrumentation shall also be NEMA 4X rated. The panel shall have a local operator for the stroke frequency control and have an analog 4 – 20 mA output to plant SCADA. Control panels shall be assembled to NFPA 79 standards and good engineering practices.

G. The piping shall be attached to the chemical metering skid with a non-metallic corrosion resistant support system. All support extensions shall be factory attached to the skid. The straps shall be removable and reusable to allow for servicing of the system. All inlet/outlet connections, valves and pump accessories shall be clearly labeled on the skid for easy identification.

H. The chemical feed skid manufacturer is also responsible for installing all control wiring from the pumps to the NEMA 4X control panel. The chemical feed skid manufacturer shall be responsible for providing a prewired and piped 120V receptacle with weatherproof cover for each skid mounted pump completely independent from the control wiring. Each skid shall have an electrical junction box that has been prewired from the 120V receptacle for the electrical contractor to tie into. The electrical contractor is responsible for running conduit and tying into skid mounted electrical junction box and installing 120V supply power to the skid.

I. The chemical metering skids shall be completely assembled and tested by the manufacturer prior to delivery to the job site.

J. The design and fabrication of the chemical metering skids shall comply with the following criteria:

1. All piping shall be fabricated to production drawings that detail all pipe nipples, fittings, valves, metering accessories, supports, etc.

2. The manufacturer prior to delivery shall hydraulically and electrically test each system. Testing shall be documented and include verification of pump performance and response to remote systems using simulation equipment as required.

2.06 LOCAL CONTROL STATION

A. A Local Control Station (LCS-56615) shall be provided and installed near the outfall dosing station to allow for local operation of the metering pumps. The LCS-56615 shall be equipped with two (2) Local/Off/Remote (LOR) switches, one for each pump. These LOR

switches shall be wired in parallel with the corresponding LOR switches located in the LCP-56615 panel, such that either switch in the pair (LCS or LCP) may place the pump in 'Local' mode. When either LOR switch is set to 'Local,' the corresponding pump shall override all remote control signals and operate at the preset speed configured on the LCP-56615 keypad. Refer to Drawing I-06.

2.07 TOOLS, SUPPLIES AND SPARE PARTS

A. The equipment manufacturer shall furnish all special tools necessary to disassemble, service, repair and adjust the equipment.

B. The manufacturer shall furnish the following for each pump:

1. Two (2) seats for suction and discharge check valves

2. Two (2) check valve balls

3. One (1) set of check valve seals

4. One (1) diaphragm

PART 3 – EXECUTION

3.01 MANUFACTURER'S FIELD SERVICES

A. The services of a qualified manufacturer's technical representative shall be provided in accordance with Section 46 00 00 – Equipment General Provisions. For each series of pumps, field services shall include the following site visits:

Service	Number of Trips	Number of Days/Trip
Installation Supervision and Testing	1	1
Startup and Training	1	1
Services after Startup	1	1

3.02 MANUFACTURERS FIELD SERVICE PROVIDER

A. The manufacturer or manufacturer's authorized service representative shall provide the services of an experienced, authorized factory-trained field service technician for the equipment specified herein who shall be present at the jobsite and/or for the services shown including required travel expenses. The duration of the service contract shall be as specified in paragraph **Error! Reference source not found.** of this section

B. The pump manufacturer's authorized and trained field service technician shall be local to Florida with a maximum of 24-hour onsite response time when required. The technician must reside within 1 hour of the facility.

3.03 INSTALLATION

A. The Contractor shall furnish and install the metering pumps and all associated equipment and accessories as required and specified herein in accordance with manufacturer's instructions and in accordance with Section 46 00 00 - Equipment General Provisions. The Contractor shall install the pumps on concrete pedestals or FRP equipment tables as indicated on the Drawings. Concrete pedestals or FRP equipment tables shall be built to the required elevation, dimensions, level, and finish.

B. All metallic fasteners, brackets, mounting hardware, and accessories located in the storage and feed areas shall be constructed of materials completely resistant to the specified chemicals.

C. The Contractor shall support piping adjacent to pumps such that no weight is carried on pump casings.

D. The Contractor shall be fully informed and shall be responsible to ensure that all Contractor's employees, agents, and/or subcontractors are fully informed as to the hazards and proper procedures associated with working with and around the specified chemicals.

3.04 TESTING, CLEANING, AND START-UP

A. Testing shall be in accordance with Section 46 00 00 – Equipment General Provisions.

B. All pumps shall be shop tested for capacity at rated pressure prior to shipment, with documented results provided.

C. After installation of piping and accessories but before connection of piping to the storage tank and pumps, the Contractor shall completely flush the system to clean and remove all foreign matter from the piping system.

D. After chemical storage tanks are hydrostatically tested and the tanks and piping system are cleaned, complete system hydrostatic tests and operational tests shall be completed with potable water. The functioning of all pump accessories, valves, and feed points shall be checked, the pressure settings of pump accessories shall be adjusted, and all malfunctioning or unsatisfactory components shall be repaired or replaced.

E. After all pumps have been completely installed, conduct in the presence of the Engineer tests to indicate that each item of equipment conforms to this Section. The manufacturer’s representative shall oversee field testing:

1. Functional Test: Check for proper alignment, rotation, excessive or unusual noises, overheating, lubrication, and satisfactory performance, demonstrating the pumps’ ability to deliver the rated capacity and operating pressure. Testing of the pumps will be at 0.5%, 2%, 4%, 50% and 100% of rated speeds. The functioning of all system components including pump accessories shall be checked.

2. Vibration test: Check and verify that each operating pump does not have excessive vibration or movement during operation over the specified speed range.

3. If the performance of any item of equipment does not meet the specified requirements, take corrective measures or remove the unit and replace with one which satisfies the conditions specified.

END OF SECTION

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SECTION 46 33 43
SOLENOID-DRIVEN CHEMICAL METERING PUMPS

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish, install, adjust, and place in satisfactory operation solenoid-driven chemical metering pump systems for chemical metering as specified herein and as shown on the Drawings. All solenoid-driven chemical metering pump systems including pumps, piping, valves, chemical containment skids, and related appurtenances mounted on the skid shall be supplied by the same manufacturer. The manufacturer shall have sole responsibility for the satisfactory manufacture and performance of the system.

B. The chemical feed system as provided by the pump manufacturer shall contain the following items:

1. Skid with integral containment and drip lip
2. Metering pumps with solenoid drive, integral control panel, microprocessor
3. Calibration column
4. Pulsation dampeners installed inline within 18 inches of the pump discharge
5. Pressure gauges with diaphragm seals
6. Ball valves
7. Pressure relief valves
8. Backpressure valves
9. All piping, valves, gaskets, supports, hardware, wiring, and accessories necessary for a fully functioning skid as specified herein and as indicated on the Drawings.

C. The complete installation shall be free from excessive vibration, cavitation, noise, and leaks.

D. The solenoid-driven chemical metering pump system manufacturer shall include a 2-year maintenance service agreement covering the provision of spare parts and service.

E. Equipment shall be provided in accordance with the requirements of Section 46 00 00 – Equipment General Provisions and Section 43 20 00 – Pumps – General.

1.02 OPERATING CONDITIONS AND PERFORMANCE REQUIREMENTS

A. Pumps and pump components shall be suitable for use in the chemical service specified herein. The Contractor is responsible for the coordination and selection of corrosion resistant materials for the chemical solutions specified herein and shall guarantee the suitability of the materials used in manufacturing the equipment.

B. Chemical Properties:

	Sodium Hypochlorite
Concentration	12.5 Trade %
Specific Gravity	1.17 @ 68°F
pH	11.5 - 13
Freezing Point	-4 - 5 °F
Viscosity	1.7 cPs @ 68°F

C. Pump Performance Requirements:

Chemical Pumped	**12.5% NaOCl**	**12.5% NaOCl**
No. of Units	2	2
Pump ID	MP-56013A, MP-56613A	MP-56013B, MP-56613B
Application Point	Reuse Pre-chlorination	Non-Potable Pre-chlorination
Rated Feed Rate	5.07 gph	5.07 gph
Required Discharge Pressure	58 psi	58 psi
Suction and Discharge Connections	SKT	SKT
Drive Type	Solenoid	Solenoid

1.03 SUBMITTALS

A. The following items shall be submitted with the Shop Drawings in accordance with, or in addition to the submittal requirements specified in Section 01 33 00 – Submittal Procedures and Section 46 00 00 – Equipment General Provisions:

1. A pump characteristic performance curve showing flow rate as a function of stroke length, stroke frequency, and pressure.

2. Details on materials of construction of all components including applicable ASTM designations.

3. Chemical resistance data for all wetted parts of pumps and accessories

4. The total weight of the equipment plus the approximate weight of shipped materials. Support locations and loads that will be transmitted to bases and foundations. Exact size, placement, and embedment requirements of all anchor bolts.

5. Dimensional drawings

6. Recommended location and mounting of pulsation dampening devices

7. Panel layout drawings, schematic wiring diagrams, and component product data sheets for control panels

8. Complete wiring diagrams

9. Complete control descriptions for pump operation

10. Complete erection, installation, and adjustment instructions and recommendations

11. Warranty documentation including statement of duration of warranty period and contact phone numbers and addresses for warranty issues

B. Shop drawings shall include all pumps and accessories and shall be submitted as a complete system. Partial submittals will be unacceptable.

1.04 WARRANTY

A. Warranty and Guarantee shall be as specified in Section 46 00 00 – Equipment General Provisions with the exception that a two (2) year factory warranty shall be provided on the Chemical-Feed Skids and Pumps from the date manufacturer's authorized service provider completes commissioning services.

1.05 MAINTENANCE AGREEMENT

A. A two (2) year maintenance agreement for the pump skids furnished and installed under this section, to be performed by the pump skid's local factory-trained service provider, shall be included with the purchase of the skid and shall include the following:

1. Alternating 6-Month and 12-Month Preventative Maintenance (PM) shall be performed by the manufacturer's authorized representative on Chemical-Feed Skids.

2. 6-Month PM service shall include retightening and tuning the skid to ensure optimum performance and that leaks are prevented or mitigated in a timely manner.

3. 12-Month PM services shall include 6-Month PM services plus changeout of all soft goods (diaphragms, ball checks, etc.) related to pumps and accessories.

4. Cycle shall repeat during the second year of operation with one more 6 Month and 12-Month PM services as described in paragraphs 2. and 3. Above.

5. Additional on-demand quarterly service visits shall be included in agreement to address any issues that arise in between scheduled PM visits.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. The Manufacturer shall be a company specializing in manufacture, assembly, and field performance of solenoid-driven metering pumps with a minimum of five years experience.

B. The metering pumps shall be gamma/X Series as manufactured by ProMinent.

2.02 GENERAL

A. The pump supplier is responsible for the coordination of corrosion- and abrasion-resistant materials for the chemical solutions specified. The manufacturer shall include all features as necessary for satisfactory operation of the pumping systems for chemical solutions specified. All pumps shall be capable of handling the designated process fluids in their full commercial strengths. Pumps and accessories shall be non-metallic and resistant to the specified chemicals to prevent corrosion.

2.03 PUMP DESCRIPTION

A. Solenoid operated chemical metering pumps shall be of the microprocessor-controlled, solenoid-driven, reciprocating, diaphragm type. Output volume shall be adjustable from zero to maximum capacity while the pumps are in operation.

B. All pumping functions shall be set by membrane switch keypad and click wheel, and status shall be displayed on an illuminated LCD. The keypad shall allow for simple scrolling and display of programmed parameters.

C. The pump shall be fully tested by the manufacturer prior to shipment to meet rated flow and pressure.

D. Pumps shall operate on 120 VAC, 60Hz, single phase power and shall be provided with internal power cord and receptacle plug. The pump supplier shall furnish all necessary control cables as required for connections. In addition, power supply cord shall be furnished when required.

E. The diaphragm shall be constructed of a solid core, vulcanized into nylon-reinforced EPDM, with a PTFE-faced fluid contact surface. The pump shall also have a diaphragm failure detector with a visible indicator of a diaphragm rupture. Fault indication and pump shut down shall be provided in the case of a diaphragm rupture.

F. The liquid end shall be physically separated from the drive unit by back plate with weep hole creating an air gap. An elastomer shaft wiper seal shall prevent contamination of the solenoid if the primary diaphragm fails.

G. The liquid end shall be virgin PVDF.

H. The liquid end shall include ball type check valves on the suction and discharge, with the balls seating on a combination valve seat and seal ring. Valve seat and seal ring shall be renewable by replacing only the combination set-seal ring.

I. Stroke length and frequency control shall be done with an integral solenoid drive. Control shall be switchable between manual or external control. In manual mode, stroke length and frequency control shall be manually adjusted by the touch keypad, with the setting displayed on the pump's LCD. In external mode, the pump shall be capable of receiving a 4-20 mA input via an optional external control cable. The metering pump shall be capable of remote ON-OFF operation using the PAUSE function via a voltage-free contact relay through an optional control cable.

J. It shall be possible to selectively slow the discharge or the suction stroke speed of the pump to accommodate application requirements and process fluid viscosity and off-gassing conditions.

K. The pump shall be equipped with two output relays:

    1. Fault alarm OR pump run indication

    2. mA Output - The current output signal indicates the pump's actual calculated metering volume.

L. For simplified operator monitoring, the pump shall be equipped with a three LED Display (Red, Yellow, and Green) to locally indicate normal operation, fault conditions, and warning conditions.

M. Operating Modes – The pump shall have the following operating modes available:

    1. Manual operating mode permitting the operation of the pump stroke and speed controls manually.

    2. Contact operating mode providing the option of controlling the pump externally by means of potential-free contacts (e.g. by means of a contact water meter). The number of pump strokes per input contact can be scaled by a factor ranging from 0.01 to 99.99 to tailor the pump feed rate to the application.

3. Batch operating mode providing the option of working with large factors (up to 99,999). Metering can be triggered either by pressing the Click wheel or by a pulse received via the "External control" terminal or through a contact or a semiconductor switching element. It is possible to pre-select a metering volume (batch) or a number of strokes using the Click wheel in the Settings menu.

4. The Analog operating mode allows the capacity and/or stroke rate to be controlled via an analog (4-20mA) current signal via the "External control" socket. The processing of the current signal can be preselected via the control unit.

2.04 PUMP ACCESSORIES

A. The metering pump supplier shall furnish accessory equipment as specified herein and as shown on the Drawings including but not limited to the following:

1. Pressure gauges shall be provided on the discharge of metering pumps in the quantities and locations as shown on the Mechanical and Instrumentation Drawings (near the pumps and near the application points). This includes gauges for piping installation for future coagulant aid polymer feed system. Gauges shall be as specified in Section 40 73 13 – Pressure and Differential Pressure Gauges. Each gauge shall have a range of zero to 100 psi. Each gauge shall be provided with a diaphragm seal as specified in Section 40 79 00 – Miscellaneous Instruments, Valves, and Fittings, constructed of materials which are completely resistant to corrosion by the chemicals referred to in this Section. Each pressure gauge shall also be provided with an isolation valve. Isolation valves shall be PVC with seals that are resistant to the chemical applications.

2. Pressure relief valves shall be supplied by the pump manufacturer in the quantities and locations as shown on the Mechanical and Instrumentation Drawings. This includes backpressure valves for piping installation for future coagulant aid polymer feed system. Valve body shall be PVC and diaphragm shall be PTFE for chemical compatibility and standardization of accessories across chemical systems; pump manufacturer to advise if they recommend an alternate material based on experience. Valve shall be provided with socket or flanged connections. Valve shall be flow-through or three-port as shown on the Drawings. Relief setting shall be field-adjustable from 5 psi to 125 psi via an adjustment screw. Sizing of the valve shall be the responsibility of the pump manufacturer. Pressure relief valves shall be manufactured by the pump manufacturer, Blacoh Fluid Control, Plast-O-Matic, or equal.

3. Backpressure / anti-siphon valves shall be supplied by the pump manufacturer in the quantities and locations as shown on the Mechanical and Instrumentation Drawings (near the pumps and near the application points). This includes backpressure valves for piping installation for future coagulant aid polymer feed system. Valve body shall be PVC and diaphragm shall be PTFE for chemical compatibility and standardization of accessories across chemical systems; pump

manufacturer to advise if they recommend an alternate material based on experience. Valve shall be provided with socket or flanged connections. Pressure setting shall be field-adjustable from 5 psi to 125 psi via an adjustment screw. Sizing of the valve shall be the responsibility of the pump manufacturer. Backpressure / anti-siphon valves shall be manufactured by the pump manufacturer, Blacoh Fluid Control, Plast-O-Matic, or equal.

4. Calibration columns shall be supplied by the pump manufacturer in the quantities and locations as shown on the Mechanical and Instrumentation Drawings. Calibration column shall be constructed of clear PVC and provided with a top cap for connection to a vent / return line. Calibration column shall have socket or flanged inlet and vent connections. Graduations shall be in mL and gallons per hour. Each calibration column shall be sized such that at 50% pump capacity, the calibration column will be emptied in 60 to 90 seconds. Calibration columns shall be manufactured by the pump manufacturer, Blacoh Fluid Control, Plast-O-Matic, or equal.

5. Pulsation dampeners and suction accumulators shall be supplied by the pump manufacturer in the quantities and locations as shown on the Mechanical and Instrumentation Drawings and as recommended by the pump manufacturer based on the system operating conditions. Pulsation dampener body shall be PVC; bladder, and bellows materials shall be PTFE for chemical compatibility and standardization of accessories across chemical systems; pump manufacturer to advise if they recommend an alternate material based on experience. Inlet connection shall be socket or flanged. The pump manufacturer shall size the dampener to remove a minimum of 90% of the pulsation from the metering pump. Dampeners shall be provided with a pressure gauge with an operating range of 0-100 psig and a charging valve. Pulsation dampeners and suction accumulators shall be manufactured by the pump manufacturer, Blacoh Fluid Control, Plast-O-Matic, or equal.

B. Piping on the suction and discharge of each metering pump shall be as specified in the Piping System Schedule at the end of Section 40 06 20 – Process Pipe, Valve, and Gate Schedules. Materials of construction shall be completely compatible with the specified chemical. Contractor shall provide transition fittings for metal pipe connected to PVC accessories or for PVC pipe connected to metal accessories.

2.05 SKID-MOUNTED FEED SYSTEMS

A. Each chemical feed system shall be completely assembled, mounted, calibrated, tested, and delivered to the site on a single skid. Components to be mounted on the skid are as indicated on the Drawings and shall include the metering pumps; piping and valves; pump accessories as specified and shown on the drawings; and wiring, electrical interface boxes, and receptacles integral to the skid. The chemical metering pump manufacturer shall be responsible for providing all equipment, valves and piping within the skid boundary.

B. Each skid shall be provided with its own local control panel. Local disconnect is provided by duplex receptacle with weatherproof cover mounted on the skid properly. Enclosures shall be NEMA 4X FRP construction. The pump control panels shall provide all the functions and interfaces as shown on the specification P&ID's, including but not limited to the following features: main circuit breaker and branch circuit breakers as needed.

C. The skids shall be constructed of fusion welded black polypropylene sheets with a minimum thickness of ½". The design of the skid shall include gussets and supports as required for all components and shall be self-supporting. The skid shall be designed with a minimum of a 2-1/2" containment lip to contain spills. Forklift truck cut outs shall also be provided. The skid shall be manufactured using continuous welding technology; bolted construction is not acceptable. Pump stands shall be provided to elevate the metering pumps above the skid base.

D. Skid system piping and valves shall be provided as specified in Division 40 – Process Interconnections and a shown on the Drawings. Piping shall include isolation valves and unions for all serviceable components. The pump connections shall be designed with replaceable pipe sections on the suction and discharge via union or flange so that pump replacement or upgrade can be accomplished without cutting into skid piping. Flexible tubing connections and quick connects shall be provided between fixed piping and suction and discharge of the pumps.

E. Each pump shall have the following devices mounted on the door of the control panel for operator interface: Local-Off-Remote (L-O-R) Illuminated selector indicating running status, Pump general alarm light, Local speed control digital potentiometer, actual speed indication when pump is provided with analog output option. Each pump shall have the following signals available for the plant SCADA / PLC via hard wire connection: Pump running status, pump alarm status, Pump speed analog feedback (optional when provided), remote mode selected status. Each pump shall accept the following signals from the plant SCADA / PLC via hard wire connection: Dry contact pump enabled, Analog 4-20mA speed command.

F. All components shall be UL listed or recognized, door mounted devices shall be NEMA 4x, 22mm, Heavy Duty, Oil Tight, and instrumentation shall also be NEMA 4X rated. The panel shall have a local operator for the stroke frequency control and have an analog 4 – 20 mA output to plant SCADA. Control panels shall be assembled to NFPA 79 standards and good engineering practices.

G. The piping shall be attached to the chemical metering skid with a non-metallic corrosion resistant support system. All support extensions shall be factory attached to the skid. The straps shall be removable and reusable to allow for servicing of the system. All inlet/outlet connections, valves and pump accessories shall be clearly labeled on the skid for easy identification.

H. The chemical feed skid manufacturer is also responsible for installing all control wiring from the pumps to the NEMA 4X control panel. The chemical feed skid manufacturer

shall be responsible for providing a prewired and piped 120V receptacle with weatherproof cover for each skid mounted pump completely independent from the control wiring. Each skid shall have an electrical junction box that has been prewired from the 120V receptacle for the electrical contractor to tie into. The electrical contractor is responsible for running conduit and tying into skid mounted electrical junction box and installing 120V supply power to the skid.

I. The chemical metering skids shall be completely assembled and tested by the manufacturer prior to delivery to the job site.

J. The design and fabrication of the chemical metering skids shall comply with the following criteria:

1. All piping shall be fabricated to production drawings that detail all pipe nipples, fittings, valves, metering accessories, supports, etc.

2. The manufacturer prior to delivery shall hydraulically and electrically test each system. Testing shall be documented and include verification of pump performance and response to remote systems using simulation equipment as required.

2.06 SPARE PARTS

A. The equipment manufacturer shall furnish all special tools necessary to disassemble, service, repair and adjust the equipment.

B. The manufacturer shall furnish the following for each pump:

1. Two (2) spare parts kits to include:

a. One (1) metering diaphragm

b. Two (2) valve assemblies

c. One (1) Connector set

d. Two (2) valve balls

PART 3 – EXECUTION

3.01 MANUFACTURER'S FIELD SERVICES

A. The services of a qualified manufacturer's technical representative shall be provided in accordance with Section 46 00 00 – Equipment General Provisions. For each series of pumps, field services shall include the following site visits during construction phase:

Service	Number of Trips	Number of Days/Trip
Installation Supervision and Testing	1	1
Startup and Training	1	1
Services after Startup	1	1

3.02 MANUFACTURERS FIELD SERVICE PROVIDER

A. The manufacturer or manufacturer's authorized service representative shall provide the services of an experienced, authorized factory-trained field service technician for the equipment specified herein who shall be present at the jobsite and/or for the services shown including required travel expenses. The duration of the service contract shall be as specified in paragraph 1.05 of this section

B. The pump manufacturer's authorized and trained field service technician shall be local to Florida with a maximum of 24-hour onsite response time when required. The technician must reside within 1 hour of the facility.

3.03 INSTALLATION

A. The Contractor shall furnish and install the metering pumps and all associated equipment and accessories as required and specified herein in accordance with manufacturer's instructions and in accordance with Section 46 00 00 - Equipment General Provisions. The Contractor shall install the pumps on FRP equipment tables as indicated on the Drawings. FRP equipment tables shall be built to the required elevation, dimensions, level, and finish.

B. All metallic fasteners, brackets, mounting hardware, and accessories located in the storage and feed areas shall be constructed of materials completely resistant to the specified chemicals.

C. The Contractor shall support piping adjacent to pumps such that no weight is carried on pump casings.

D. The Contractor shall be fully informed and shall be responsible to ensure that all Contractor's employees, agents, and/or subcontractors are fully informed as to the hazards and proper procedures associated with working with and around the specified chemicals.

3.04 TESTING, CLEANING, AND START-UP

A. Testing shall be in accordance with Section 46 00 00 – Equipment General Provisions.

B. All pumps shall be shop tested for capacity at rated pressure prior to shipment, with documented results provided.

C. After installation of piping and accessories but before connection of piping to the storage tank and pumps, the Contractor shall completely flush the system to clean and remove all foreign matter from the piping system.

D. After the piping system is cleaned, complete system operational tests shall be completed with potable water. The functioning of all pump accessories, valves, and feed points shall be checked, and all malfunctioning or unsatisfactory components shall be repaired or replaced.

E. After all pumps have been completely installed, conduct in the presence of the Engineer tests to indicate that each item of equipment conforms to this Section. The manufacturer's representative shall oversee field testing:

1. Functional Test: Check for proper alignment, excessive or unusual noises, overheating, and satisfactory performance, demonstrating the pumps' ability to deliver the rated capacity and operating pressure. Testing of the pumps will be at 0.5%, 2%, 4%, 50% and 100% of rated speeds. The functioning of all system components including pump accessories shall be checked.

2. Vibration test: Check and verify that each operating pump does not have excessive vibration or movement during operation over the specified speed range.

3. If the performance of any item of equipment does not meet the specified requirements, take corrective measures or remove the unit and replace with one which satisfies the conditions specified.

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SECTION 46 33 67.1

MAGNETICLY COUPLED THERMOPLASTIC CENTERFUGAL PUMPS

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish, install, and place in satisfactory operation magnetic drive centrifugal pumps for chemical transfer at the location shown on the Drawings and as specified herein. All pumps shall be supplied by the same manufacturer.

B. The complete installation shall be free from excessive vibration, cavitation, noise, and chemical leaks.

C. Equipment shall be provided in accordance with the requirements of Section 46 00 00 – Equipment General Provisions and Section 43 20 00 – Pumps – General.

1.02 OPERATING CONDITIONS AND PERFORMANCE REQUIREMENTS

A. Pumps and pump components shall be suitable for use in the chemical service specified herein. The equipment manufacturer is responsible for the coordination and selection of corrosion resistant materials for the chemical solutions specified herein and shall guarantee the suitability of the materials used in manufacturing the equipment.

B. Chemical Properties

	Sodium Hypochlorite
Concentration	12.5% Trade %
Specific Gravity	1.17 @ 68°F
pH	11.5 - 13
Viscosity	-4 - 5 °F
Vapor Pressure	1.7 cPs @ 68°F

01-16-2024

C. Pump Performance Requirements

Service	Sodium Hypochlorite (12.5% Trade % Solution)
Number of Units	1
Design Capacity (gpm)	60
Design Dynamic Head (feet)	36
Rated Horsepower	2
Pump / Motor Speed (rpm)	1,750
Motor Electrical	208V / 3ph / 60hz
Temperature of Liquid Pumped	Ambient
Suction Condition	Flooded
Suction and Discharge Connections	FPT & MPT

1.03 SUBMITTALS

A. The following items shall be submitted in accordance with, or in addition to the submittal requirements specified in Section 01 33 00 – Submittal Procedures and Section 46 00 00 – Equipment General Provisions:

1. A pump performance curve for pumping chemicals with specific gravity specified above.

2. Details on materials of construction of all components including applicable ASTM designations.

3. Chemical resistance data for all wetted parts of pumps and accessories.

4. The total uncrated weight of the equipment plus the approximate weight of shipped materials. Support locations and loads that will be transmitted to bases and foundations. Exact size, placement, and embedment requirements of all anchor bolts.

5. Dimensional drawings, including recommended location of anchor bolts.

6. Motor data sheet indicating motor horsepower; enclosure type; voltage; insulation class; temperature rise tests; service-rating; rotative speed; motor speed-torque relationship; efficiency and power factor; and safe running time-current curves.

7. Equipment and motor protective device details. Connection diagrams for motor and all protective devices.

8. Complete wiring diagrams.

9. Complete erection, installation, and adjustment instructions and recommendations.

10. Warranty documentation including statement of duration of warranty period and contact phone numbers and addresses for warranty issues.

1.04 WARRANTY AND GUARANTEE

A. Warranty and Guarantee shall be as specified in Section 46 00 00 – Equipment General Provisions with the exception that the warranty period shall be for one (1) year.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. The Manufacturer shall be a company specializing in manufacture, assembly, and field performance of magnetic drive centrifugal pump. Manufacturer of pumps must have at least 20 operating installations in domestic water or wastewater treatment plants located in the United States over a period of at least seven years pumping the same fluid as specified.

B. The pumps shall be March Pumps TE Series 7.5K magnetically driven seal-less centrifugal pump, or equal.

2.02 GENERAL

A. The pump supplier is responsible for the coordination of corrosion- and abrasion-resistant materials for the chemical solutions specified. The manufacturer shall include all features as necessary for satisfactory operation of the pumping systems for chemical solutions specified. All pumps shall be capable of handling the designated process fluids in their full commercial strengths. Pumps, motors and accessories shall be non-metallic or shall be coated with a heavy-duty protective epoxy coating resistant to the specified chemicals to prevent corrosion.

2.03 MATERIALS AND CONSTRUCTION

A. These Specifications shall be considered as minimum requirements, and the Contractor shall inform himself of the practices and experiences of similar pumping units handling these solutions. The manufacturer shall add such additional features as are necessary for satisfactory functioning and shall guarantee the suitability of the materials used in the manufacture of the recirculation pumps.

B. The transfer pump shall be horizontal, end suction, centrifugal type ANSI pump with casing of Kynar construction with all wetted parts suitable for the intended chemical service.

C. The common pump shall be Kynar and motor base shall be FRP suitably constructed to support the full weight of pump and motor and provided with grout holes and drain connections with drip lip. All FRP bases shall be grout filled after installation. Anchor bolts shall be Hastelloy C. The base shall provide easy access to the seal area. All metal parts shall be protected with chemical grade epoxy coatings suitable for the intended service. Fasteners shall be Hastelloy C.

D. Impeller shall be closed type, one-piece construction, and Kynar. Magnets shall be fully encapsulated.

E. Shafting shall be ceramic with ceramic thrust washer.

F. O-Rings shall be constructed of materials completely resistant to corrosion for the specified chemical service Viton or Teflon.

G. Magnetic coupling shall be neodymium iron boron for maximum strength. The coupling shall be properly sized to effectively transmit the required torque over the full range of specified pump performance without slipping or decoupling. Pump systems shall be cooled by internal circulation of process fluid through the coupling minimizing heat rise and providing bearing lubrication.

2.04 ELECTRICAL AND CONTROL REQUIREMENTS

A. All conduit, couplings, fittings, and fasteners furnished by the equipment manufacturer shall be PVC coated rigid galvanized steel and liquid tight, PVC coated, flexible metal conduit.

B. Electrical Requirements

Motors	Transfer Pump
Rating	208V, 3 ph, 60 Hz
Horsepower	2
Speed, rpm	3450
Enclosure	TEFC
Insulation	Class F
Inverter Duty	No
Service Factor	1.15
Space Heater	No
Motor Winding Temperature Switches	Yes

2.05 SPARE PARTS

A. Spare parts shall be provided in accordance with Section 46 00 00 – Equipment General Provisions and shall include the following for each series of pumps:

1. One (1) pump impeller with bushing

2. Two (2) sets of front and rear thrust washers

3. One (1) pump shaft

4. Two (2) housing O-rings

PART 3 – EXECUTION

3.01 MANUFACTURER'S FIELD SERVICES

A. The services of a qualified manufacturer's technical representative shall be provided in accordance with Section 46 00 00 – Equipment General Provisions. For each series of pumps, field services shall include the following site visits:

Service	Number of Trips	Number of Days/Trip
Installation and Testing	1	1
Startup and Training	1	1
Services after Startup	1	1

3.02 INSTALLATION

A. The Contractor shall furnish and install the magnetic drive centrifugal pumps and all associated equipment as required and specified herein in accordance with manufacturer's instructions and in accordance with Section 46 00 00 - Equipment General Provisions. The Contractor shall install the pumps on concrete pedestals or FRP equipment tables as indicated on the Drawings. Concrete pedestals or FRP equipment tables shall be built to the required elevation, dimensions, level, and finish.

B. All metallic fasteners, brackets, mounting hardware, and accessories located in the storage and feed areas shall be constructed of materials completely resistant to the specified chemicals.

C. The Contractor shall support piping adjacent to pumps such that no weight is carried on pump casings.

D. The Contractor shall be fully informed and shall be responsible to ensure that all Contractor's employees, agents, and/or subcontractors are fully informed as to the

hazards and proper procedures associated with working with and around the specified chemicals.

3.03 TESTING, CLEANING, AND START-UP

A. Testing shall be in accordance with Section 46 00 00 – Equipment General Provisions.

B. All pumps shall be shop tested for capacity at rated pressure prior to shipment, with documented results provided.

C. After installation of piping and accessories but before connection of piping to the storage tank and pumps, the Contractor shall completely flush the system to clean and remove all foreign matter from the piping system.

D. After chemical storage tanks are hydrostatically tested and the tanks and piping system are cleaned, complete system hydrostatic tests and operational tests shall be completed with potable water. The functioning of all pumps shall be checked, and all malfunctioning or unsatisfactory components shall be repaired or replaced.

E. After all pumps have been completely installed, conduct in the presence of the Engineer tests to indicate that each item of equipment conforms to this Section. The manufacturer's representative shall oversee field testing:

1. Functional Test: Check for proper alignment, rotation, excessive or unusual noises, overheating, lubrication, and satisfactory performance.

2. Vibration test: Check and verify that each operating pump does not have excessive vibration or movement during operation.

3. If the performance of any item of equipment does not meet the specified requirements, take corrective measures or remove the unit and replace with one which satisfies the conditions specified.

END OF SECTION

SECTION 46 41 42
CHEMICAL INJECTION ASSEMBLIES

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish, install, test, adjust, and place in satisfactory operation chemical injection assemblies as shown on the Drawings and as specified herein.

B. Equipment shall be provided in accordance with the requirements of Section 46 00 00 - Equipment General Provisions, and Division 40 – Process Interconnections.

1.02 OPERATING CONDITIONS AND PERFORMANCE REQUIREMENTS

A. Chemical Injection Assemblies

Service	**Sodium Hypochlorite**	**Sodium Hypochlorite**	**Sodium Hypochlorite**	**Sodium Hypochlorite**
Application Point	Non-potable and Reuse Perchlorinating	Non-potable and Reuse CCT (0.25”), Outfall (1”)	Influent Pump Station, RAS 1-5	Headworks
No. of Assemblies	2	6	6	2
Type of Feed Device	Retractable Injector	Fixed Injector	Fixed Injector	(1)
Maximum Concentration	18% (12.5% intended)	18% (12.5% intended)	18% (12.5% intended)	18% (12.5% intended)
Injector Size	0.25”	0.25” (4), 1” (2)	0.75”	0.375”
Injection Quill Type	Standard Service	PVC Service	PVC Service	PVC Service
Chemical Pipe Material	PVC	PVC	PVC	PVC
Maximum Chemical Feed Rate	5.07 gph	11.3gph, 275gph	93.3 gph	26.7 gph
Max Chemical Discharge Pressure	58 psi	145 psi, 58 psi	58 psi	58 psi
Receiving Pipe Diameter	24”	3”, 4”	3”	(1)
Receiving Pipe Material	Ductile Iron	PVC Sch 80	PVC Sch 80	(1)
Maximum Receiving Pipe Pressure	13 psi	75 psi	75 psi	(1)
Maximum Receiving Pipe Velocity	5 fps	5 fps	5 fps	5 fps

1. Coordinate with separate Headworks Odor Control improvement project.

1.03 SUBMITTALS

A. The following items shall be submitted with the Shop Drawings in accordance with, or in addition to, the submittal requirements specified in Section 01 33 00 – Submittal Procedures, and Section 46 00 00 – Equipment General Provisions:

1. Equipment specifications and data sheets, with identification of all materials of construction.

2. Complete assembly, layout, installation and shop drawings, with clearly marked dimensions, tolerances, jointing and anchoring details.

3. Weights of equipment component parts.

4. Chemical resistance data for wetted parts.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. The chemical injection assemblies shall be as manufactured by SAF-T-FLO Water Services, Inc., Koflo, or approved equal.

2.02 CONSTRUCTION AND MATERIALS

A. Each injection assembly shall be specifically designed for the particular chemical service for which it is being supplied. The materials of construction for the assemblies shall be compatible with the chemicals being fed and shall be suitable for the pressure in the chemical solution line and receiving pipe, the maximum velocity in the receiving pipe, and the insertion length.

B. Acceptable injection assembly construction shall be as follows:

Standard Service and PVC Service Quill	Sodium Hypochlorite
Isolation Valve	Threaded CPVC or Brass (standard service only)
Tube	PVC or CPVC
Tip Configuration	45° Bevel on small quills, SAF-T-Seal Tip (FKM) on available quill sizes
Check Valve Material	PVC or CPVC with Titanium springs and Ceramic ball
Check Valve Seal	FKM
Flexible Tubing Assembly:	
Valve	CPVC or PVC
Seal	FKM
Tubing	Reinforced PVC
End Connection	Compression Tube Fitting with FNPT

C. The injection assemblies shall be retractable for the standard service quills and furnished with an isolation assembly, solution tube assembly including check valve , SAF-T-Seal (for available quill sizes), locking device, and a safety chain for the standard service quill. The locking device shall connect the solution tube to the corporation stop on the receiving pipe to prevent accidental withdrawal of the solution tube. A stainless steel safety chain shall prevent the solution tube from being withdrawn past the compression ring in the gland. Safety chain length shall be determined by the manufacturer based on solution tube length.

D. The assemblies shall be sized to match the pump discharge line or injection flow rate and shall be of the same diameter as the chemical piping. The injection assembly solution tubes shall penetrate into the pipe a distance equivalent to a minimum of 1/3 of the pipe diameter into which the chemicals are being injected.

E. Each injector shall be furnished with a flexible hose assembly consisting of flexible hose/tubing, connection fittings, seals and ball valve, specifically designed for the particular chemical service for which it is being supplied. Flexible hose assembly shall also be capable of withstanding maximum pump discharge line pressure.

PART 3 – EXECUTION

3.01 MANUFACTURER'S FIELD SERVICES

A. The services of a qualified manufacturer's technical representative shall be provided in accordance with Section 46 00 00 – Equipment General Provisions.

Service	Number of Trips	Number of Days/Trip
Installation, Testing, and Training	1	1

3.02 INSTALLATION

A. The Contractor shall furnish the chemical injectors and all associated equipment and accessories as required and specified herein in accordance with the manufacturer's instructions and in accordance with Section 46 00 00 – Equipment General Provisions.

END OF SECTION

ATTACHMENT D – TECHNICAL SPECIFICATIONS

APPENDIX A – GEOTECHNICAL REPORT

ISSUED FOR INFORMATIONAL PURPOSES ONLY

ATTACHMENT D – TECHNICAL SPECIFICATIONS

APPENDIX A – GEOTECHNICAL REPORT

ISSUED FOR INFORMATIONAL PURPOSES ONLY

KBC
CONSULTANTS, INC.

THOMAS J. KADERABEK P.E.
DAVID BARRERO P.E.
MARTIN A. CALL P.E.

September 13, 1990

Paul J. Vinci, P.E.
Hazen and Sawyer, P.C.
5950 Washington Street
Hollywood, Florida 33023

Re: Report of Subsurface Exploration and
Geotechnical Consulting Services
Chlorination and Pump Upgrade Projects
City of Hollywood Southern Regional Wastewater
Treatment Plant Expansion
Taft Street and North 14 Avenue
Hollywood, Florida
KBC Project No. 88163-A

Dear Mr. Vinci:

We submit this Report in fulfillment of a scope of services described in our Proposal No. 90-301, dated August 20, 1990. We were authorized to perform work via acceptance of our Professional Services Agreement.

This Report contains the data collected, the procedures used, our evaluation, and specific recommendations related to the proposed construction. An Executive Summary presents the highlights of our work effort.

EXECUTIVE SUMMARY

The City of Hollywood Wastewater Treatment Plant Facility is located north of Hollywood Boulevard, south of Sheridan Street and about five blocks east of the U.S. Highway 1 in Broward County, Florida. The proposed plant expansion will cover an L-shaped area of about 400 by 300 feet along the eastern edge of the plant, south of the main entrance. Site grades in the area of the Wastewater Treatment Plant are generally on the order of +5 feet NGVD.

The proposed plant expansion will consist of a variety of structures as described in the project information section of this report. Structural loads transmitted to the subsurface will be primarily from structural dead loads and live loads from contained

fluids. Foundation area loadings are expected to range from about 850 to 1,500 psf.

The generalized subsurface conditions consist of a 4-foot layer of fill soils overlying a 4 foot layer of compressible silt. The next stratum encountered is the Miami Limestone which is a sandy calcareous partially cemented limestone having a thickness of about 18 feet. The Miami Limestone is relatively non-compressible. Below these strata we encountered a layer consisting of sand, limestone, and sandstone which had a thickness of about 80 feet based on previous site studies. The above described subsurface conditions were explored using eight standard penetration test borings, nine test excavations, five laboratory identification tests, and one full scale pumping test. The stabilized groundwater was encountered at approximate elevation 0 to +1 feet NGVD.

The compressible silt strata, if left in place, will result in large settlements as a result of the proposed construction. However, following site preparation, which will include silt removal, shallow foundations can be used for support of the proposed structures. Following site preparation total settlements at the center of the heaviest structures are predicted to be about 1 inch.

Recommendations are provided for shallow foundations for support of plant structures following site preparation. Site preparation will consist of removal of the silt strata and replacement with granular material. Pressure grouted auger piles are recommended as a foundation alternate. Piles may be necessary if site preparation activities (excavations), interfere with support of existing structures or utilities.

PROJECT INFORMATION

KBC Consultants, Inc., initially became involved in this project when we submitted a Report of Geotechnical Consulting Services dated May 5, 1989; which addressed plant expansion consisting of clarifiers, RAS/WAS structure, and oxygenation structure. This report addresses an additional plant expansion/modification.

The City of Hollywood Wastewater Treatment Plant Facility is located north of Hollywood Boulevard, south of Sheridan Street and about five blocks east of the U.S. Highway 1 in Broward County, Florida. The proposed plant expansion will cover an L-shaped area of about 400 by 300 feet, along the eastern edge of the plant just south of the main entrance. Site grades in the area of the Wastewater Treatment Plant are generally on the order of +5 feet NGVD.

Information about this project was obtained during a meeting held in Hazen and Sawyer, P.C. offices on August 17, 1990; we received the following documents to aid us in the preparation of this proposal: Hazen and Sawyer Drawing Nos. ALT-1, ALT-2, ALT-3, and M-9, undated; a

photocopy of a site photograph; and a meeting agenda sheet which included preliminary structural loadings and criteria.

The proposed plant expansion will consist of a variety of structures as shown in Table 1. Structural loads transferred to the subsurface will be primarily from structural dead and live loads from contained fluids. Foundation area loadings are expected to range from about 850 to 1,500 psf.

Table 1
Proposed Structures and Loading Conditions
Hollywood Wastewater Treatment Plant
KBC Project No. 88163-A

Proposed Structure	Plan Area feet	Top of Slab Elevation, ft.	Foundation Stress,psf
Chlorine Building	35 by 120	+7	850
Odor Scrubber	40 by 40	Unknown	850
Polished Water Pump Sta.	90 by 50	+7	850
Polishing Filters	130 by 20	+7	1500
Chlorine Contact Tanks	130 by 20	+7	1500
Filter Feed Pump Sta.	45 by 35	+3	850
Wet Well for Pumps	10 by 40	-2	1500
Diesel Pads	20 by 30	+7	850

We understand that the majority of site grades following plant expansion will be on the order of +7 feet NGVD. In other words, placement of fill soils will be limited to about 2 feet associated with plant expansion. Excavations associated with plant expansion are anticipated to facilitate below ground construction (primarily foundations).

PURPOSE

The purpose of our services on this project was to explore the subsurface conditions, evaluate the subsurface response to structural loading, and provide foundation recommendations.

KBC

This study contains the following specific information:

- Project Vicinity Map which indicates the relative location of this project relative to Broward County landmarks.
- Test Location Plan Drawing which indicates proposed new construction as it relates to field test locations.
- Generalized Subsurface Profile which graphically represent the subsurface conditions encountered.
- Legend Sheet and Notes which explain abbreviations used in the Generalized Subsurface Profile and the Records of Test Boring.
- Records of Test Boring for eight standard penetration test borings which were each 50 feet deep.
- Results of nine test excavations performed with a hydraulic backhoe.
- Results of a field pumping test performed within a test excavation using a pump to measure discharge and draw down.
- Results of laboratory tests which include five Grain Size Analysis Tests.
- Estimates of engineering properties based on field and laboratory test data, our past experience, and correlations to published literature.
- An estimate of settlement as a result of proposed construction.
- A discussion of shallow foundations for support of the proposed construction.
- A discussion of the use of pile foundations for the proposed construction.
- A discussion related to construction dewatering.
- Recommendations for shallow foundation design.
- Recommendations related to pile foundations.
- Recommendations related to ground floor slab support.
- Recommendations for site preparation.
- Recommendations related to geotechnical construction involvement.

KBC

SITE AND SUBSURFACE CONDITIONS

Site Conditions - The Hollywood Wastewater Treatment Plant is located in eastern Broward County between U.S. Highway 1 and the Atlantic Ocean just south of Sheridan Street. General site grades within the Wastewater Plant are on the order of +5 feet NGVD.

The site conditions were observed by Thomas J. Kaderabek on March 21, 1989 and by George deVassal on August 27, 1990. Portions of the area proposed for plant expansion are currently covered with vegetation consisting of low grasses and dense shrubs. Other portions of the site were open and could be accessed with pick-up trucks and drilling equipment.

Field Tests - The field tests for this geotechnical study consisted of: soil test borings, test excavations, and a full scale pumping test. The test locations are as shown on the appended Drawing No. 1. The test locations shown are approximate and were located by scaling and measuring from existing site features. Ground surface elevations at test locations were estimated using engineering judgement and survey information which was provided to us.

A total of eight standard penetration test borings were performed to depths of 50 feet below ground surface. The standard penetration test was used as the investigative tool within the borings. Penetration tests were performed in accordance with ASTM Procedure D-1586, Penetration Test and Split-Barrel Sampling of Soils. This test procedure drives a 1.4-inch I.D. split-tube sampler into the soil profile using a 140-pound hammer falling 30 inches. The number of blows required to drive the sampler the second and third 6-inch increments is an indication of soil strength. Portions of the soil and rock samples recovered were placed in plastic containers and transported to our laboratory.

The soil samples recovered were classified and stratified by a geotechnical engineer. The results of the classification and stratification are shown on the appended Records of Test Boring. The results of the soil borings are graphically represented on the attached Generalized Subsurface Profile. It should be noted that soil conditions may vary between soil borings and between the strata interfaces which are shown. The soil boring data reflects information from the specific test location only.

A total of nine test excavations were performed for this study. A hydraulic excavator was used for the excavation process. An engineering geologist from our office classified and stratified the soil samples encountered during the excavation process. The attached Records of Test Excavation summarize the data collected.

A single pump test was performed within test excavation TE-1 at the location shown on the appended Drawing No. 1. The pump test was

performed by excavating into the soil profile to the maximum reach of the hydraulic equipment. The dimensions of the test excavation were recorded along with the elevation of the stabilized groundwater. Next, a pump with a 100-gallon per minute capacity was introduced to the test location in order to record discharge. The data recorded during the field pumping test is included in the Appendix of this Report on the Record of Test Excavation. We have also included data from a previous pump test performed in March 1989, Results of Field Pumping Test, pages A-34 and A-35.

Laboratory Tests - A total of five laboratory identification tests were performed for this study. The five grain size analysis tests were performed on cohesionless soil samples. Grain size analysis tests were performed in accordance with ASTM Procedures D-422. The results of the laboratory identification tests are shown in the Appendix of this Report on grain size distribution sheets.

Local Geology - Broward County is located on the southern flank of a stable carbonate platform on which thick deposits of limestones, dolomites, and evaporites have accumulated. The upper 200 feet of the soil profile is composed predominantly of limestone and quartz sand. These sediments were deposited during several glacial and interglacial stages when the ocean was at elevations higher than present.

Florida is divided into two geomorphic provinces: the Central Highlands and the Coastal Lowlands. The Coastal Lowlands encompass all of South Florida and consist of plains representing marine terraces which have been modified by erosion.

The Coastal Lowlands are further subdivided into regions called the Everglades, the Big Cypress Swamp, the Mangrove and Coastal Glades, the Sandy Flatlands and the Atlantic Coastal Ridge. The Atlantic Coastal Ridge approximates U.S. Highway 1 or a high elevation ridge. This project site is located in the Coastal Glades Region.

The near-surface rock formation in Dade and Broward County is referred to as the Miami Limestone. The Miami Limestone is a soft to moderately hard, tan-white, porous to very porous, sometimes sandy, oolitic calcareous cemented grainstone. The Miami Limestone has a maximum thickness of about 35 feet along the Atlantic Coastal Ridge and thins sharply near the coastline and more gradually in a westerly direction. The Miami Limestone was formed about 130,000 years ago at a time when the sea level was twenty-five feet higher than it is today. This environment facilitated formation of concentrically layered sand sized carbonate grains called oolites. These grains formed by repeated precipitation of calcium carbonate around the nucleus of a sand or shell grain.

The Miami Limestone is underlain by the Fort Thompson formation. The Fort Thompson Formation includes sand, sandstone, and limestone. The Fort Thompson Formation is wedge shaped, having a thickness of

about 60 feet in the Miami area and thinning to a thickness of about 10 feet in the western portions of the County.

Subsurface Conditions - The field tests performed for this project disclosed subsurface conditions consistent with the geology described above. The initial soil layer, encountered between elevations +6 to +2 feet, consisted of sand, fine gravel, or a combination of these two materials. We interpret this layer to be fill soil. Beneath the fill layer in the elevation range +2 to -2 feet NGVD, a silt strata was encountered which had a trace of peat and a trace of sand. Next, Miami Limestone Formation was encountered which had a total thickness of about 18 feet. Beneath the Miami Limestone either sand or sand mixed with fine gravel sized limestone fragments was encountered. This strata had a thickness of about 85 feet based on previous work completed at this site. A summary of the subsurface conditions encountered along with their engineering properties are included in the Evaluation section of this Report in Table 2.

The detailed subsurface conditions which were encountered are indicated on the Records of Test Boring and Records of Test Excavation. The subsurface conditions are represented graphically in the attached Generalized Subsurface Profiles. Subsurface conditions may vary between test locations.

Groundwater Hydrology - Two principal aquifer systems have been defined in South Florida, the Floridian Aquifer and the Biscayne Aquifer. The Floridian Aquifer is chiefly composed of limestone and dolomite, interbedded with minor amounts of sand, silt and clay. The depth of the top of the Floridian Aquifer, locally, is approximately 1,000 feet with the base occurring at approximately 3,700 feet.

The Biscayne Aquifer is a surficial aquifer system composed of limestone, sandstone, sand, shell, silt, clay and a mixture of these materials often occurring in discontinuous sequences. Generally, the Biscayne Aquifer is contained within the following sequence of ascending formations: Tamiami Formation, Fort Thompson Formation, Key Largo Limestone, Anastasia Formation, Miami Limestone, and Pamlico Sand.

Primarily, the aquifer is recharged by local rainfall. Aquifer discharge occurs principally by evapotranspiration, pumping for public water supply, and general unrestricted flow into the ocean. The aquifer, however, is regulated by the South Florida Water Management District through a network of natural rivers and man made canals to maintain a degree of consistency in the groundwater level. Unusual conditions, such as hurricanes and extended drought periods, may result in uncontrolled large scale fluctuations of the groundwater level.

Over the past thirty years variations in water levels in the general vicinity of the project, on an average basis, have ranged from

elevation 0 to +3 feet NGVD. These elevations are consistent with the groundwater levels encountered for this geotechnical study.

Variations in groundwater elevations can occur for a wide variety of reasons such as: rainfall activity, hurricane storms, water management practices, nearby construction activity, drought or flood cycles and other factors. Variations in groundwater elevation should be expected and planned for.

EVALUATION

Engineering Properties - We have used information from our field and laboratory tests, our past experience, and correlations to published literature to estimate engineering properties for the various soil/rock strata encountered on this project. We have subdivided the subsurface profile into a variety of strata for the purpose of our evaluation. Engineering properties are indicated in Table 2.

TABLE 2
ESTIMATED ENGINEERING PROPERTIES
HOLLYWOOD WASTEWATER TREATMENT PLANT
KBC Project No. 90130

Elevation Range, Feet, NGVD	Average SPT N-valve Blows/Foot	Soil Modulus value, ksf	Soil/Rock Description
+6 to +2	Varies	250 (Reference 1)	Sand/Gravel (Fill)
+2 to -2	5	50 (Reference 3)	Silt
-2 to -20	25	8000 (Reference 6)	Miami Limestone
-20 to -45	18	300 (Reference 1)	Sand

Foundation Requirements - A foundation must meet three requirements for successful design and construction: bearing capacity, settlement, and environmental factors. Shallow foundations are initially considered because of their relative economy. If shallow foundations do not meet allowable design requirements for bearing capacity, settlement, and environmental factors, then deep foundations (piles) or soil improvement are considered.

The soil bearing capacity is the soil's ability to support loads without plunging into the soil profile. Bearing capacity failures are analogous to shear failures in structural design and are usually sudden and catastrophic. Shallow foundations are designed so that columns do not plunge into the soil profile. Analytical techniques for soil bearing capacity estimation generally apply to sands, clays and silts. In a cemented deposit or rock formation, bearing capacity is evaluated using techniques such as factor of safety against punching shear failure, factor of safety against beam tension failure, and factor of safety against crushing.

Foundation allowable bearing pressures and bearing elevations must be adjusted so as to provide margins of safety against bearing capacity failure. Allowable bearing pressures of 3 ksf or higher are available at this site for shallow foundation design following the recommended site preparation.

Another requirement of a shallow foundation is the ability of the structure to tolerate the predicted settlement. The following parameters are necessary in order to estimate settlement: footprint bearing pressure, stress reduction factor, thickness of each compressible underlying stratum, modulus of each stratum, and foundation dimensions. We have used this information to predict total settlement for shallow foundations as shown in Table 3. The settlement estimates assume the silt strata is removed and the recommended site preparation is completed.

Table 3
Estimated Total Settlements
Hollywood Wastewater Treatment Plant
KBC Project No. 88163-A

Proposed Structure	Bearing Elev.,ft.	Foundation Stress,psf	Estmtd. Total Settlement, in
Chlorine Building	+7	850	1/2
Odor Scrubber	+7	850	1/2
Polished Water Pump Sta.	+7	850	1/2
Polishing Filters	+7	1500	1
Chlorine Contact Tanks	+7	1500	1
Filter Feed Pump Sta.	+3	850	1/2
Wet Well for Pumps	-2	1500	1/2
Diesel Pads	+7	850	1/2

The allowable amount of settlement that a structure may tolerate is dependent on several factors including: uniformity of settlement, time rate of settlement, structural dimensions, and properties of the structural materials. Generally, total or uniform settlement does not damage a structure but may affect drainage and utility connections. These can generally tolerate movements of several inches for building construction. In contrast, differential settlement affects a structure's frame and is limited by the structural flexibility.

Many designers are unwilling to accept any settlement, and for this reason select a deep foundation system. However, choosing a pile system is not a guarantee against settlement; many pile systems have undergone significant settlement.

A common criteria for allowable settlement is to limit differential settlement to 1/300 of the span length which would be 1.2 inches for a 30-foot span (Reference 5). We estimate differential settlements on this projects will be about one half the total settlement listed in Table 3; over a lateral distance of 30 feet. Considering the granular nature of soils present at this site, we expect settlements will be coincidental with the application of building loads.

The final requirement for a shallow foundation is to resist environmental factors such as soil shrinking, soil swelling, hurricane scour, sinkholes, or soil freezing. In our professional opinion an environmental force which will act on shallow foundations at this site will be the possibility of hurricane scour removing soil from beneath the shallow foundations. In our opinion, this environmental factor will have a low probability (on a scale of low, medium, high) of occurring at this project site. While hurricanes may occur during the life of the proposed structure, the inland location of the site has resisted hurricane scour in the past. A detailed evaluation of hurricane scour acting on shallow foundations at this site was outside the scope of our study.

Existing Foundations on Site - The Hollywood Wastewater Treatment Facility was visited by an engineer from our office who met with the plant superintendent Mr. Ernest Atkins in January 1989. The facility was initially constructed in 1957 with the majority of structures being supported on shallow foundations following removal of the silt layer. Mr. Atkins informed us that to the best of his knowledge foundation and structural performance has been satisfactory. We were informed that several of the "deeper" pump station type structures were constructed using "caisson type" construction.

Foundations from a partially removed secondary clarifier are currently in place and buried under the area of the proposed chlorine building. Test excavations were performed over the buried clarifier bottom, however, the equipment reach was not sufficient to expose the slab bottom reported to be at elevation -3.5 to -4.5 feet NGVD.

Shallow Foundations - It is our professional opinion that shallow foundations can be used at this site only if the silt layer is removed and the recommended site preparation is completed. The silt layer present does not have sufficient factor of safety against bearing capacity failure; and total and differential settlements of the silt layer will be larger than those which can be tolerated by the structures. Two options are available; remove the silt layer or use piles to transfer the load to a deeper soil strata. Based on our past experience and knowledge working with various types of foundations it is our opinion that removing the 4 foot thick silt layer is a cost effective solution for structure support.

Shallow foundations for proposed construction will bear between approximate elevations +5 feet and -4 feet NGVD or about 1 to 9 feet below existing site grade. We utilized an allowable bearing pressure of 3 ksf which provides for a factor of safety in excess of 3. Estimates for total shallow foundation settlement following site preparation are shown in Table 3.

Pile Foundations - Pile foundations are also a technical solution to supporting structural loads. Pile foundations are considered a technical alternate when site restrictions will not permit removal of the silt strata. Based on our past experience, the two foundation types which are cost effective, provide good technical performance, and can be installed by local contractors are: driven concrete piles and pressure grouted auger piles. We favor auger piles on this project because of their lack of installation vibration, speed of installation, and effective load transfer into the Miami Limestone strata. Allowable tension and compression capacities for pressure grouted auger piles are shown in Table 4. Tension pile reinforcement should be designed by a structural engineer. We predict piles installed following the recommendations provided in this Report will experience settlements of about 1/4-inch under working compression loads.

Table 4
ALLOWABLE TENSION AND COMPRESSION CAPACITIES
PRESSURE GROUTED AUGER PILES
KBC PROJECT NO. 88163-A

Nominal Pile Diameter, in.	Tip Elevation, Feet, NGVD	Allowable Compression Capacity, tons	Allowable Tension Capacity, tons
14	-20	55	30
16	-20	65	35
18	-20	75	40

Excavations - Excavations for this project are anticipated. Excavations will be necessary to accomplish site preparation, i.e., removal of the silt layer. Temporary side slopes around the perimeter of the excavation will remain stable at an approximate slope of 1:1 (H:V). In some instances, flatter temporary slopes may be necessary especially when excavations extend below groundwater in sandy or silty materials. If excavations will encroach on temporary side slopes or threaten the stability of existing structures/utilities, then earth retention systems should be used to protect the integrity of existing structures.

Excavations into the Miami Limestone strata have been completed with conventional excavation equipment; sometimes equipped with rock digging tools.

Materials which are excavated on site and meet gradation requirements recommended in this report may be used as compacted fill.

Dewatering - Full scale pump tests were performed at this site in August 1990 and March 1989. An excavation 8 feet into the Miami Limestone, with a plan area of 16 by 1.5 feet had the groundwater lowered from elevation 0 to -8 feet over a time interval of about 60 minutes while pumping at a rate of about 150 gpm.

The pump test performed in August 1990 was performed in an excavation which was about one foot into the Miami Limestone. The groundwater during this test was lowered from +1 to -4 feet NGVD, over a time interval of 2 minutes pumping at a rate of 55 gpm.

Clarifier construction on this site in 1989-1990 used open pumping to dewater the construction site for the purpose of silt removal, fill placement, and clarifier sump construction. Discussions between the writer and Hazen and Sawyer,P.C. indicates that open pumping from sumps was successful in that construction application.

The exact method of site dewatering should be a contractor decision. The ease or difficulty of dewatering this site will be a function of the contractors "ways and means"; the capacity, quantity, and number of pumps will be effect the success of a dewatering program.

Evaluation Summary - Shallow foundations can be utilized for the support of the structures listed in the project information section of this report. Site preparation for these structures will involve removal of the silt strata and/or previously placed fill. Shallow foundations can use an allowable bearing pressure of 3 ksf when bearing on compacted fill or in-situ limestone. Total settlements are predicted to range from 1/2 to 1 inch depending on the structural loading condition.

Pressure grouted auger piles with compression capacities ranging from 55 to 75 tons can be used as a foundation alternate if removal of

the silt layer cannot be accomplished without undermining existing foundations or utilities.

Temporary excavations will remain stable on side slopes of about 1:1 (H:V) for granular materials located above the Miami Limestone. Excavations in the cemented Miami Limestone will remain stable with vertical slopes.

Recommendations related to our evaluation are included in the next section of this report.

RECOMMENDATIONS

Basis for Recommendations - We provide the following recommendations based on the data collected at this site and our understanding of the proposed construction at the Hollywood Wastewater Treatment Plant. If the size, location, or type of structural loads change we should be advised of these changes in writing so that we can review and possibly modify the recommendations presented below. In light of the above discussion we provide the following recommendations on this project.

Shallow Foundation Recommendations -

- The structures listed in Table 1 can be designed utilizing shallow foundations following the site improvement which is recommended below. Shallow foundations can be any one of the following or any combination: strip footings, wall footings, mats, or isolated footings beneath columns.
- Shallow foundations should bear between elevation -2 and +6 feet NGVD and can utilize an allowable bearing pressure of 3 ksf.
- A modulus of subgrade reaction equivalent to 100 pci is recommended for a mat design bearing within the Miami Limestone or on compacted fill.
- Shallow foundations should be constructed 1 foot below exterior finished grade.
- Shallow foundations should be constructed 1 foot above the stabilized groundwater level or provisions should be made for localized dewatering efforts and firm stable bearing surfaces.
- The concrete base to the abandoned clarifier located in the area of the proposed chlorine building may be left in place. However, the fill soils overlying the concrete base should be removed and recompacted as described in the site preparation section below.

Site Preparation Recommendations -

- Geotechnical site preparation should be initiated by stockpiling the initial strata of fill soils for future use provided these fill soils meet the gradation requirements specified below.

- The silt strata encountered at this site should be removed over a plan area of the proposed foundations plus a distance of 10 feet.

- If proposed excavations undermine or weaken foundation soils for existing plant structures then earth retention systems should be designed/constructed to support lateral earth pressures or a pile foundation system should be used to support structural loads.

- The silt layer located beneath the groundwater should be removed using a drag line or hydraulic excavator. The equipment should operate in an organized fashion so as to remove silt from one edge of the excavation to the other; so as not to trap silt within the undercut area.

- Backfill soils should be placed in standing water. The backfill soils should be placed about 1 foot above stabilized groundwater.

- Backfill should consist of AASHO A-2 gradation material. Less than 10% of the material should pass the No. 200 sieve.

- The fill soils should be placed at one edge of the excavation and pushed to the other so as to move residual silt across the bottom of the excavation. The leading edge of the fill should be cleaned regularly to clean it of the advancing silt layer. This excavation backfilling process should be carefully observed by the geotechnical engineer.

- Once fill soils have been placed 1 foot above the groundwater, then the entire lift should be rolled with six passes from a 10-ton roller. The overlapping coverages should occur while a compactor operates at a travel speed of not more than 2 feet per second. If a vibratory compactor is used, it should be operated with the vibrator off so as not to induce capillary moisture into the dry fill soils.

- Fill soils placed following this initial lift should be compacted to 95% of Modified Proctor Maximum Dry Density.

- Backfill soils should be placed within 2% of Optimum Moisture Content.

- The compaction operation should be documented by performing field density tests with one test being performed for each 2,500 square feet of fill area per lift of fill.

- The silt soils removed during the undercutting process are contaminated with peat and organic soils and should be removed from the site. These soils can be used as topsoil if properly stored and drained. We do not recommend that these soils be used beneath building or pavement areas.

Auger Pile Recommendations -

- We recommend pressure grouted auger piles be used as a foundation alternate if the silt strata cannot be removed without undermining existing structures on site.

- Auger piles used to support structures should be installed to elevation -20 feet NGVD for allowable compression capacities of 55, 65, and 75 tons for respective nominal diameters of 14, 16, and 18 inches.

- Pressure grouted auger piles used as uplift or anchor piles within the plant structures will have allowable tension capacities of 30, 35, and 40 tons for respective nominal diameters 14, 16, and 18 inches. These capacities are for piles installed to a tip elevation of -20 feet NGVD.

- The structural engineer should design tension piles with vertical steel reinforcement to extend the entire installed pile length. Nominal steel reinforcement should also be installed in the top portions of compression piles.

- A pile load test shall be performed to twice the pile working capacity as directed by the South Florida Building Code.

- The cement grout used in auger cast pile installation should develop a compressive strength of 4,000 psi at an age of twenty-eight days.

- Auger cast pile drilling equipment shall be equipped with a minimum of 4,000 pound of dead weight to facilitate the drilling process.

- When the auger cast pile drilling process is completed and the pumping of cement grout begins, fluid return shall occur at the ground surface before starting withdrawal of the auger.

- A positive head of grout pressure is required at the auger tip. Pressure gauges will be required to be calibrated, located, and installed at both pump and the crane leads.

- Production piles should be designed with a minimum center-to-center spacing of three pile diameters.

- Production auger cast piles closer than six pile diameter center-to-center shall not be installed until initial grout set occurs on the first pile and an additional four hours time have elapsed.

- Pressure grouted auger piles shall be installed within two inches of the staked locations and within 2% of vertical.

Recommendations for Geotechnical Construction Involvement -

- The geotechnical engineer should observe the silt removal process and the backfilling operation.

- The geotechnical engineer should observe the proofrolling process associated with the first layer of fill soils being placed.

- Density tests should be performed on all fill soils which are compacted in place.

- The geotechnical engineer should be involved with the installation of pressure grouted auger piles.

- The geotechnical engineer should observe shallow foundation bearing conditions before the placement of reinforcing steel and structural concrete.

- The geotechnical engineer should be involved with evaluating field problems as they arise and recommending solutions.

- The geotechnical engineer should review the final plans and specifications.

Recommendations for Grade Slab -

- Grade slabs within the plant site can be supported on compacted fill following the removal of the silt strata provided the site preparation techniques suggested herein are followed.

- If the alternate pile foundation system is used then a structural slab and grade beam system should be used to transmit floor loads to the pile foundation system.

KBC

REFERENCES

1. Webb, D.L., Settlement of Structures on Sandy Sediments in Durban, South Africa, Conference on In-situ Behavior of Soil and Rock, Institute of Civil Engineers, 1969.

2. Tall Silos on Soft Limestone, by T.J. Kaderabek, Symposium on Engineering Geology and Soil Engineering, Pocatello, Idaho, March 1982.

3. Geotechnical Engineering for 3,200 Acre Development, ASCE, South Florida Section Annual Meeting, 1983, Cape Coral, Florida, prepared by T.J. Kaderabek.

4. Settlements Beneath Preload Test Fill, by Kaderabek and Reynolds, ASCE Volume 105, No. GT6, June 1979.

5. Foundation Engineering and Soil Mechanics by George Sowers, McMillan Publishing Co., New York, New York, 1979.

6. Miami Limestone Foundation Design and Construction, by Kaderabek and Reynolds, Journal of Geotechnical Engineering Division, ASCE, Volume 107, No. GT7, July 1981.

7. Design Manual: Soil Mechanics, Foundations, and Earth Structures, NAVFAC DM-7, March 1971, Department of the Navy, Alexandria, VA.

8. Foundation Modulus for Mat on Sand, by G. F. Sowers, ASCE Fall Convention, San Francisco, CA., October 17, 1977.

9. Suggested Analysis and Design Procedures for Combined Footings and Mats, ACI Structural Journal Committee Report, ACI 336.2R-88, May-June 1988.

10. Elastic Solutions for Soil and Rock Mechanics, Poulos and Davis, 1974, John Wiley and Sons, Inc., New York.

REPORT LIMITATIONS

This consulting Report has been prepared for the exclusive use of Hazen and Sawyer, P.C. and the project owners related to the construction of additions and modifications to a Wastewater Treatment Plant located in Hollywood, Florida. The recommendations have been prepared in general accordance with generally accepted local soil and foundation engineering practices. No other warranty is expressed or implied.

The evaluation and recommendations submitted in this Report are based in part upon the data collected from the field exploration program. The nature and extent of variations throughout the subsurface profile may not become evident until the time of construction. If variations then become evident, it will be

necessary to re-evaluate the recommendations provided in this Report.

In the event changes occur in the nature, design, or location of the proposed construction, our recommendations as contained in this Report shall not be considered valid unless the changes are reviewed and our recommendations modified or verified in writing, by KBC Consultants, Inc.

KBC Consultants, Inc., should be provided the opport ity to review final foundation design drawings and specifications, to verify that our recommendations have been properly interpreted and implemented.

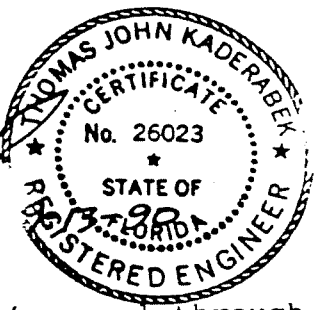
KBC Consultants, Inc., should be afforded the opportunity to provide construction observation services during the geotechnical site preparation and foundation installation phases of this project. In the event that we are not retained in this capacity, we cannot accept responsibility for the execution of our recommendations as provided in this Report.

CLOSURE

We have enjoyed the opportunity to work with you during the design portions of this project a d look forward to a continued involvement during construction.

Sincerely,

KBC CONSULTANTS, INC.



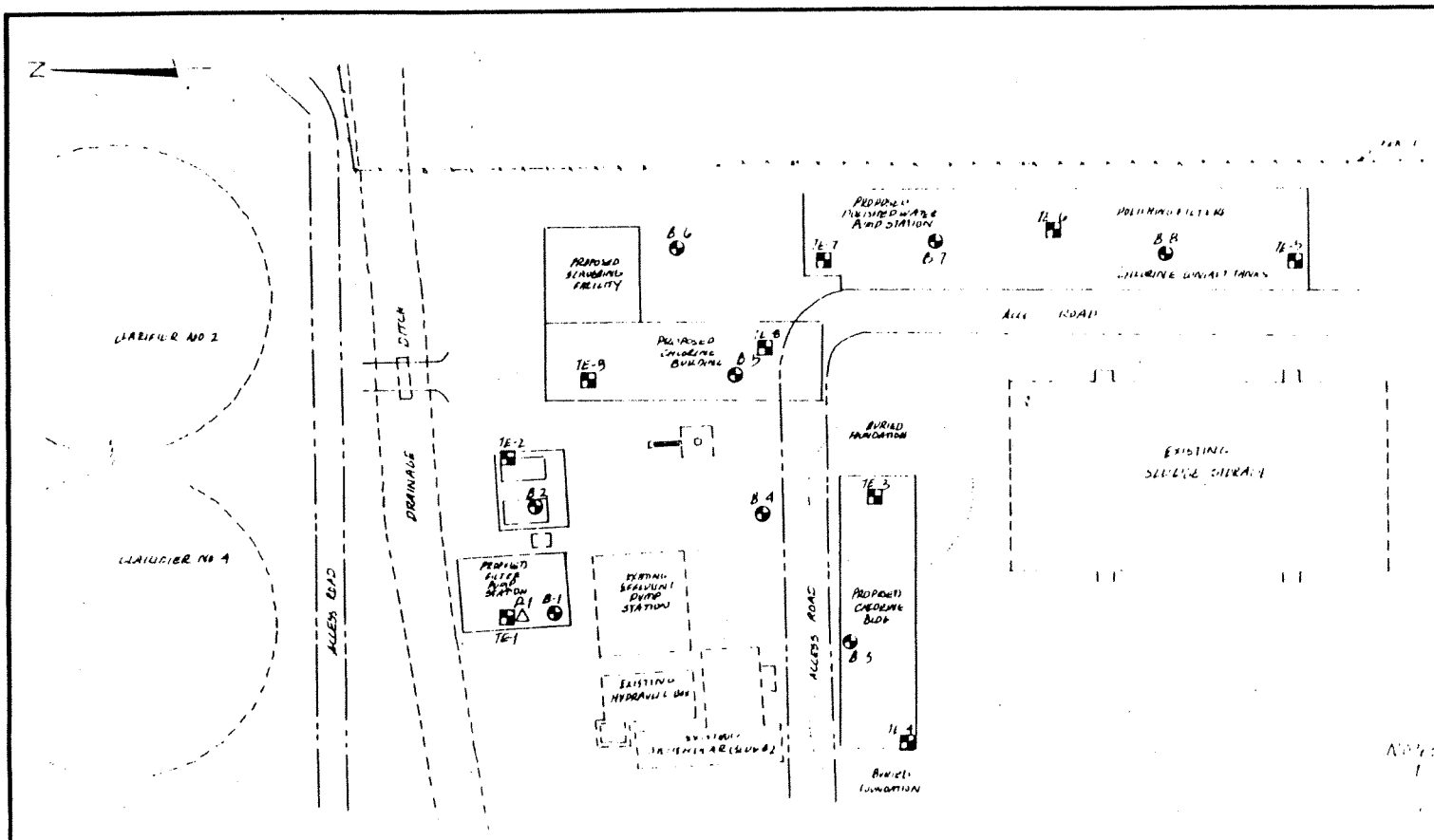
Thomas J. Kaderabek, P.E.
Principal

Attachments: Report Text (pages 1 through 18)
Appendix (A-1 through A-35)

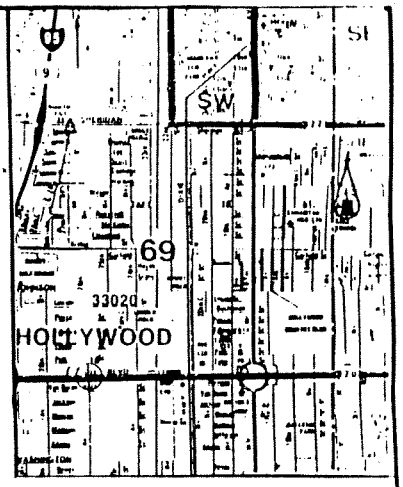
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Copy for KBC files

File: tjkrepor®hollywtp.990

KBC



TEST LOCATION PLAN



SITE LOCATION PLAN

NOTES:

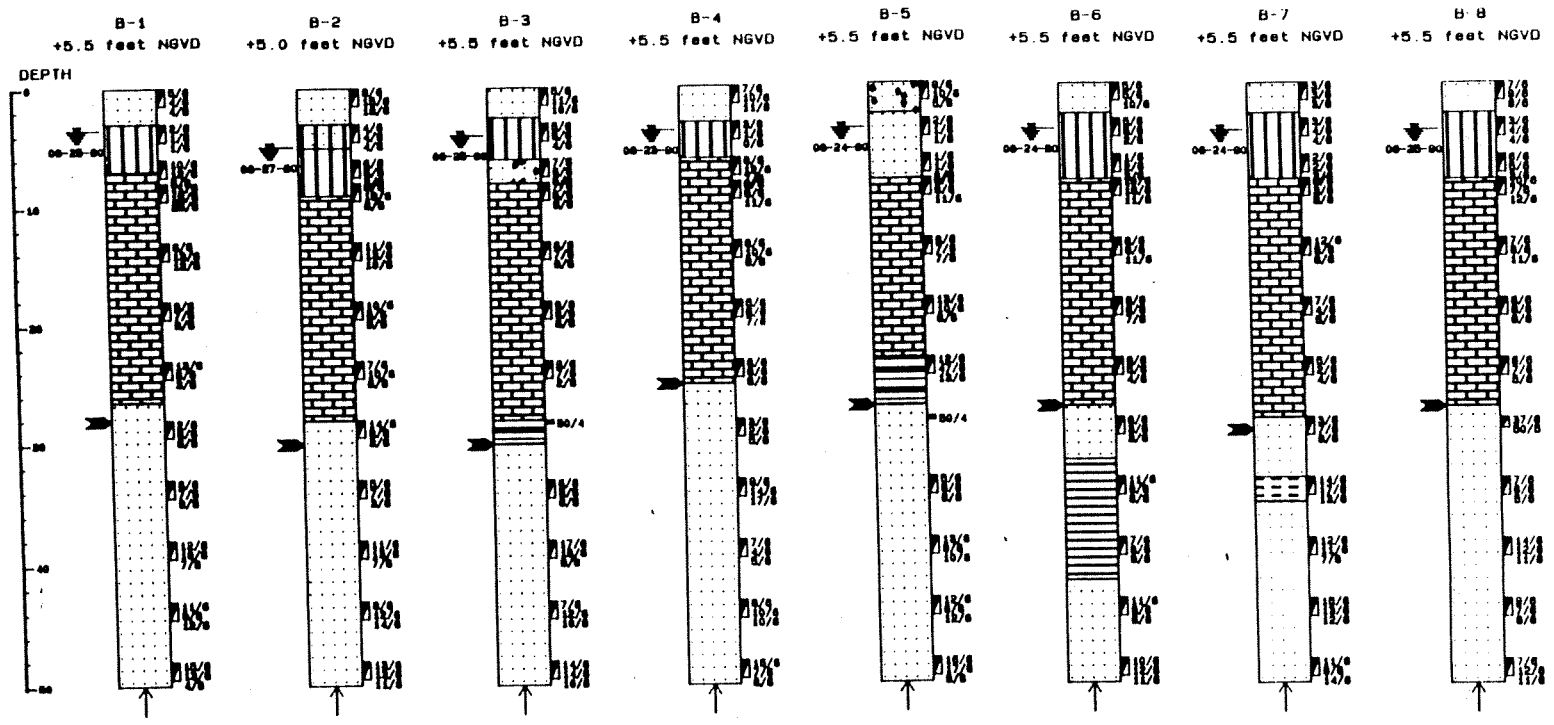
1. TEST LOCATIONS ARE APPROXIMATE
2. [illegible]
3. [illegible]

SCALE: 1" = [illegible]'

- B-1 - BORING TEST LOCATION
- TE-1 - TEST EXCAVATION LOCATION
- [illegible]

KBC CONSULTANTS, INC
GEOTECHNICAL SERVICES

DWG. TITLE
PROGRAM
PROJECT
DATE



Legend.

Symbol	Description.	Symbol	Description.
	SAND		SILT
	FINE GRAVEL (MIAMI LIMESTONE)		SAND AND SILT
	FINE GRAVEL AND SAND		HARD LIMESTONE (SPT N-VALUE > 50)
	FINE GRAVEL (FORT THOMPSON LIMESTONE)		FINE GRAVEL (FORT THOMPSON SANDSTONE)
14	Standard penetration test, 140 lb. hammer dropped 30"		Groundwater level measured at boring completion, the date checked is indicated
	Drill fluid loss.		Boring termination depth

KBC CONSULTANTS INC.
GEOTECHNICAL SERVICES

NOTES RELATED TO RECORDS OF TEST BORING AND GENERALIZED SUBSURFACE PROFILE

KBC Consultants, Inc., Miami, Florida

1. Groundwater level was encountered and recorded (if shown) following the completion of the soil test boring on the date indicated. Fluctuations in groundwater levels are common; consult report text for a discussion.
2. The boring location was identified in the field by offsetting from existing reference marks and using a cloth tape and survey wheel.
3. The borehole was backfilled to site grade following boring completion, and patched with asphalt cold patch mix when pavement was encountered.
4. The Record of Test Boring represents our interpretation of field conditions based on engineering examination of the soil samples.
5. The Record of Test Boring is subject to the limitations, conclusions and recommendations presented in the Report text.
6. "Field Test Data" shown on the Record of Test Boring indicated as 11/6 refers to the Standard Penetration Test (SPT) and means 11 hammer blows drove the sampler 6 inches. SPT uses a 140-pound hammer falling 30 inches.
7. The N-value from the SPT is the sum of the hammer blows required to drive the sampler the second and third 6-inch increments.
8. The soil/rock strata interfaces shown on the Records of Test Boring are approximate and may vary from those shown. The soil/rock conditions shown on the Records of Test Boring refer to conditions at the specific location tested; soil/rock conditions may vary between test locations.
9. Relative density for sands/gravels and consistency for silts/clays are described as follows:

SPT, BLOWS/FOOT	CPT, KG/CM²	SANDS/GRAVELS RELATIVE DENSITY	SPT, BLOWS/FOOT	CPT, KG/CM²	SILTS/CLAYS CONSISTENCY
0 - 4	0 - 16	Very loose	0 - 1	0 - 3	Very soft
5 - 10	17 - 40	Loose	2 - 4	4 - 9	Soft
11 - 20	41 - 80	Firm	5 - 8	10 - 17	Firm
21 - 30	81 - 120	Very firm	9 - 15	18 - 31	Stiff
31 - 50	over 120	Dense	16 - 30	32 - 60	Very stiff
			31 - 50	over 60	Hard

10. Grain size descriptions are as follows:

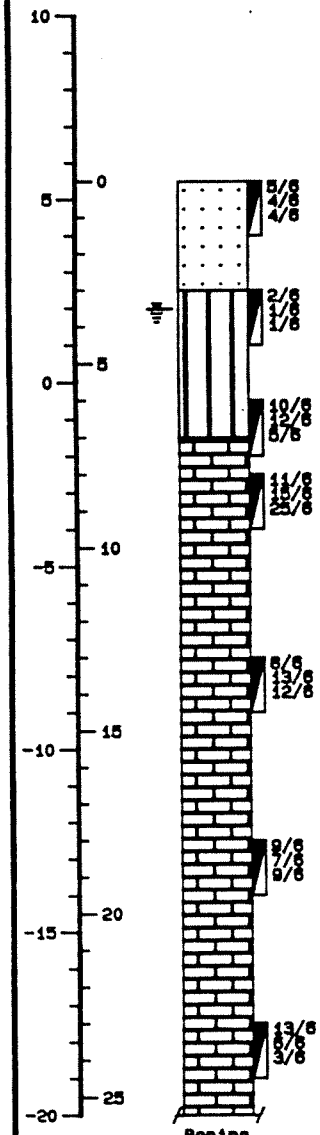
NAME	SIZE LIMITS
Boulder	12 Inches or more
Cobbles	3 to 12 Inches
Coarse Gravel	3/4 to 3 Inches
Fine Gravel	No. 4 sieve to 3/4 inch
Coarse Sand	No. 10 to No. 4 sieve
Medium Sand	No. 40 to No. 10 sieve
Fine Sand	No. 200 to No. 40 sieve
Fines	Smaller than No. 200 sieve

11. Definitions related to adjectives used in soil/rock descriptions:

PROPORTION	ADJECTIVE	APPROXIMATE ROOT DIAMETER	ADJECTIVE
About 10%	with a trace	Less than 1/32"	Fine roots
About 25%	with some	1/32" to 1/4"	Small roots
About 50%	and	1/4" to 1"	Medium roots
		Greater than 1"	Large roots

RECORD OF TEST BORING

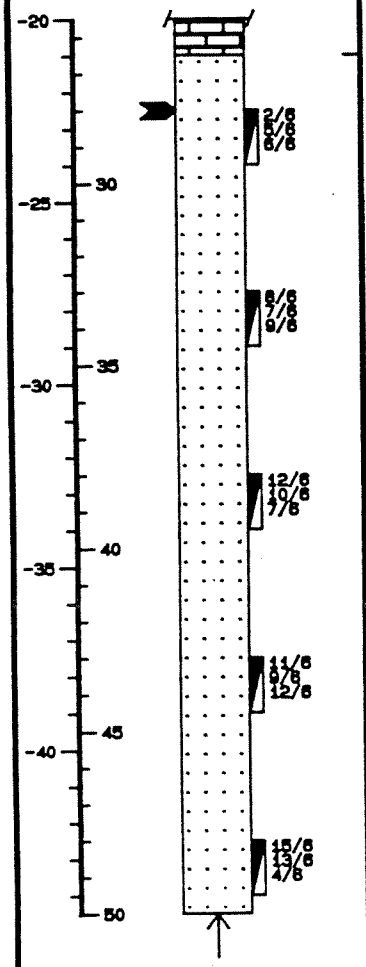
PROJECT/LOCATION: Hollywood WWTP / Broward County, FL BORING NO: B-1
PROJECT NO: 88163A START: 08-25-90 FINISH: 08-25-90 WEATHER: Part.Cloud
BORING LOCATION: See Test Location Drawing DRILLER: W. Wallace
DRILL: Mobile B-80 DRILL CONTRACTOR: KBC Inspection and Testing, Inc.
ELEV.: +5.5 feet NGVD GROUNDWATER: 3.5 feet DATE GWL CHECKED: 08-25-90
BORING METHOD: Rotary drill w/ drill mud and casing FLUID LOSS: 28 feet

ELEV. / DEPTH	SOIL SYMBOLS AND FIELD TEST DATA	MAJOR SOIL COMPONENT	OTHER COMPONENTS
10 / 0		SAND	Loose, gray-black, slightly silty with trace of limestone.
5 / 5		SILT	Soft, gray-brown, with some sand.
0 / 10		FINE GRAVEL (MIAMI LIMESTONE)	Firm, tan, with some sand.
-5 / 15			Dense, tan, with trace of sand.
-10 / 20			Very firm, light gray, with some sand.
-15 / 25			Firm, gray.
-20			Loose, gray, with some sand.

Refer to Notes and Legend on separate sheet for additional information.
This Record of Test Boring is part of the project Geotechnical Report.
Soil samples collected using ASTM D-1586 test procedures. Rock core samples collected using ASTM D-2113 test procedures.

RECORD OF TEST BORING

PROJECT/LOCATION: Hollywood WWTP / Broward County, FL BORING NO: B-1
PROJECT NO: 88163A START: 08-25-90 FINISH: 08-25-90 WEATHER: Part.Cloud
BORING LOCATION: See Test Location Drawing DRILLER: W. Wallace
DRILL: Mobile B-80 DRILL CONTRACTOR: KBC Inspection and Testing, Inc.
ELEV.: +5.5 feet NGVD GROUNDWATER: 3.5 feet DATE GWL CHECKED: 08-25-90
BORING METHOD: Rotary drill w/ drill mud and casing FLUID LOSS: 28 feet

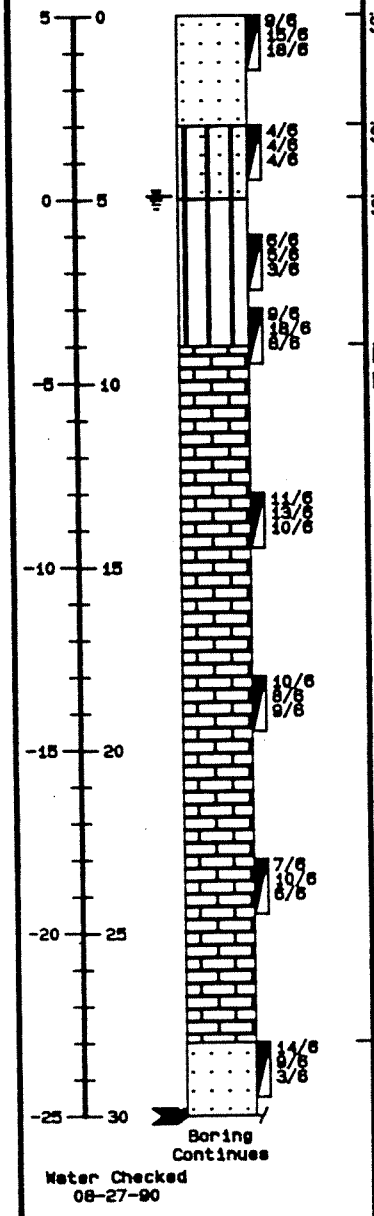
ELEV. / DEPTH	SOIL SYMBOLS AND FIELD TEST DATA	MAJOR SOIL COMPONENT	OTHER COMPONENTS
-20 / 30		SAND	Firm, gray-tan.
-25 / 35			Firm, gray-tan.
-30 / 40			Firm, greenish-gray.
-35 / 45			Firm, greenish-gray with some sandstone fragments.
-40 / 50			Firm, greenish-gray, with some sandstone fragments.

Refer to Notes and Legend on separate sheet for additional information.
This Record of Test Boring is part of the project Geotechnical Report.
Soil samples collected using ASTM D-1586 test procedures. Rock core samples collected using ASTM D-2113 test procedures.

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RECORD OF TEST BORING

PROJECT/LOCATION: Hollywood WWTP / Broward County, FL BORING NO: B-2
PROJECT NO: 88163A START: 08-27-90 FINISH: 08-27-90 WEATHER: N/A
BORING LOCATION: See Test Location Drawing DRILLER: W. Wallace
DRILL: Mobile B-80 DRILL CONTRACTOR: KBC Inspection and Testing, Inc.
ELEV.: +5.0 feet NGVD GROUNDWATER: 4.9 feet DATE GWL CHECKED: 08-27-90
BORING METHOD: Rotary drill w/ drill mud and casing FLUID LOSS: 30 feet

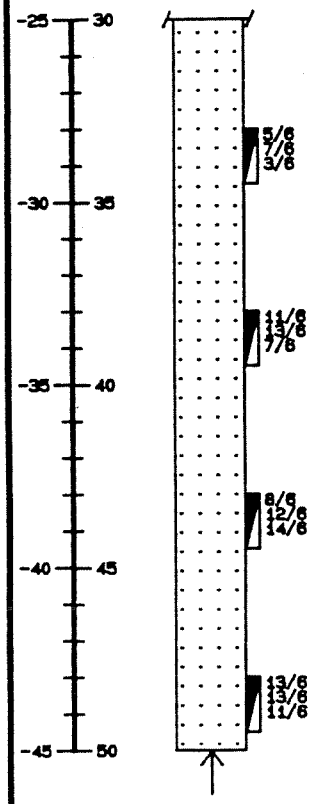


MAJOR SOIL COMPONENT	OTHER COMPONENTS
SAND	Dense, gray-brown, with some silt and limestone fragments.
SAND AND SILT	Firm, dark gray, with trace of limestone fragments.
SILT	Firm, dark gray, with some sand.
	Very firm, tan, with some sand.
FINE GRAVEL (MIAMI LIMESTONE)	
	Very firm, light tan, with some sand.
	Firm, lihgt tan, with some sand.
	Firm, light tan, with some sand.
SAND	Firm, tan, shelly.

Refer to Notes and Legend on separate sheet for additional information.
This Record of Test Boring is part of the project Geotechnical Report.
Soil samples collected using ASTM D-1586 test procedures. Rock core samples collected using ASTM D-2113 test procedures.

RECORD OF TEST BORING

PROJECT/LOCATION: Hollywood WWTP / Broward County, FL BORING NO: B-2
PROJECT NO: 88163A START: 08-27-90 FINISH: 08-27-90 WEATHER: N/A
BORING LOCATION: See Test Location Drawing DRILLER: W. Wallace
DRILL: Mobile B-80 DRILL CONTRACTOR: KBC Inspection and Testing, Inc.
ELEV.: +5.0 feet NGVD GROUNDWATER: 4.9 feet DATE GWL CHECKED: 08-27-90
BORING METHOD: Rotary drill w/ drill mud and casing FLUID LOSS: 30 feet

ELEV. / DEPTH	SOIL SYMBOLS AND FIELD TEST DATA	MAJOR SOIL COMPONENT	OTHER COMPONENTS
-25 — 30 -30 — 35 -35 — 40 -40 — 45 -45 — 50			Loose, tan, slightly shelly, with some sandstone fragments. Very firm, greenish-gray, with trace of sandstone fragments. Very firm, greenish-gray, with trace of sandstone fragments. Very firm, greenish-gray with some sandstone fragments.

Refer to Notes and Legend on separate sheet for additional information.
This Record of Test Boring is part of the project Geotechnical Report.
Soil samples collected using ASTM D-1586 test procedures. Rock core samples collected using ASTM D-2113 test procedures.

KBC CONSULTANTS, INC.

RECORD OF TEST BORING

PROJECT/LOCATION: Hollywood WWTP / Broward County, FL BORING NO: B-3
PROJECT NO: 88163A START: 08-25-90 FINISH: 08-25-90 WEATHER: N/A
BORING LOCATION: See Test Location Drawing DRILLER: W. Wallace
DRILL: Mobile B-80 DRILL CONTRACTOR: KBC Inspection and Testing, Inc.
ELEV.: +5.5 feet NGVD GROUNDWATER: 4.0 feet DATE GWL CHECKED: 08-25-90
BORING METHOD: Rotary drill w/ drill mud and casing FLUID LOSS: 30 feet

ELEV. / DEPTH	SOIL SYMBOLS AND FIELD TEST DATA	MAJOR SOIL COMPONENT	OTHER COMPONENTS
10 / 0	5/6, 11/6, 10/6	SAND	Very firm, brown, silty, with some limestone fragments.
5 / 5	5/6, 5/6, 4/6	SILT	Stiff, dark brown, with some sand and limestone fragments.
0 / 10	7/6, 6/6, 5/6	FINE GRAVEL AND SAND	Firm, tan.
-5 / 15	7/6, 5/6, 9/6	FINE GRAVEL (MIAMI LIMESTONE)	Firm, light gray, with some sand.
-10 / 20	8/6, 7/6, 9/6		Firm, light gray, with trace of sand.
-15 / 25	9/6, 6/6, 8/6		Firm, light tan, with some sand.
-20 / 30	9/6, 7/6, 2/6		Loose, light tan, with trace of sand.

Boring Continues

Water Checked 08-25-90

Refer to Notes and Legend on separate sheet for additional information.
This Record of Test Boring is part of the project Geotechnical Report.
Soil samples collected using ASTM D-1586 test procedures. Rock core samples collected using ASTM D-2113 test procedures.

KBC CONSULTANTS, INC.

RECORD OF TEST BORING

PROJECT/LOCATION: Hollywood WWTP / Broward County, FL BORING NO: B-3
PROJECT NO: 88163A START: 08-25-90 FINISH: 08-25-90 WEATHER: N/A
BORING LOCATION: See Test Location Drawing DRILLER: W. Wallace
DRILL: Mobile B-80 DRILL CONTRACTOR: KBC Inspection and Testing, Inc.
ELEV.: +5.5 feet NGVD GROUNDWATER: 4.0 feet DATE GWL CHECKED: 08-25-90
BORING METHOD: Rotary drill w/ drill mud and casing FLUID LOSS: 30 feet

ELEV. / DEPTH	SOIL SYMBOLS AND FIELD TEST DATA	MAJOR SOIL COMPONENT	OTHER COMPONENTS
-20 / 30	50/4	HARD LIMESTONE (SPT N-VALUE > 50)	hard, gray-tan, with some sand.
-25 / 35	6/6, 5/6, 6/6	SAND	Firm, greenish-gray, with some sandstone fragments.
-30 / 40	17/6, 15/6, 9/6		Very firm, greenish-tan, with trace of sandstone fragments.
-35 / 45	7/6, 12/6, 10/6		Very firm, greenish-tan, with trace of sandstone fragments.
-40 / 50	14/6, 14/6, 10/6		Very firm, greenish-tan, with trace of sandstone fragments.

Refer to Notes and Legend on separate sheet for additional information.
This Record of Test Boring is part of the project Geotechnical Report.
Soil samples collected using ASTM D-1586 test procedures. Rock core samples collected using ASTM D-2113 test procedures.

KBC CONSULTANTS, INC.

RECORD OF TEST BORING

PROJECT/LOCATION: Hollywood WWTP / Broward County, FL BORING NO: B-4
PROJECT NO: 88163A START: 08-23-90 FINISH: 08-23-90 WEATHER: Sunny/Hot
BORING LOCATION: See Test Location Drawing DRILLER: W. Wallace
DRILL: Mobile B-80 DRILL CONTRACTOR: KBC Inspection and Testing, Inc.
ELEV.: +5.5 feet NGVD GROUNDWATER: 3.7 feet DATE GWL CHECKED: 08-23-90
BORING METHOD: Rotary drill w/ drill mud and casing FLUID LOSS: 25 feet

ELEV. / DEPTH	SOIL SYMBOLS AND FIELD TEST DATA	MAJOR SOIL COMPONENT	OTHER COMPONENTS
10 / 0	7/6, 10/6, 11/6	SAND	Very firm, dark brown, silty, wit some limestone fragments.
5 / 5	3/6, 1/6, 0/6	SILT	Very soft, brown, with trace of sand.
0 / 10	8/6, 12/6, 7/6	FINE GRAVEL (MIAMI LIMESTONE)	Firm, light gray, with some silty sand.
	6/6, 9/6, 11/6		Firm, tan, with some sand.
-5 / 15	8/6, 10/6, 8/6		Firm, light tan, with some sand.
-10 / 20	5/6, 6/6, 7/6		Firm, light tan, with some sand.
-15 / 25	6/6, 6/6, 6/6		Firm, gray, with trace of sand.
-20	Boring Continues	SAND	

Water Checked 08-23-90

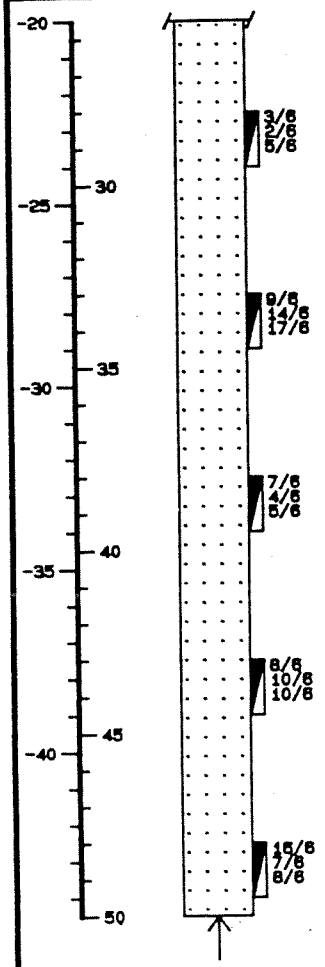
Refer to Notes and Legend on separate sheet for aditional information.
This Record of Test Boring is part of the project Geotechnical Report.
Soil samples collected using ASTM D-1586 test procedures. Rock core samples collected using ASTM D-2113 test procedures.

KBC CONSULTANTS, INC.

RECORD OF TEST BORING

PROJECT/LOCATION: Hollywood WWTP / Broward County, FL BORING NO: B-4
PROJECT NO: 88163A START: 08-23-90 FINISH: 08-23-90 WEATHER: Sunny/Hot
BORING LOCATION: See Test Location Drawing DRILLER: W. Wallace
DRILL: Mobile B-80 DRILL CONTRACTOR: KBC Inspection and Testing, Inc.
ELEV.: +5.5 feet NGVD GROUNDWATER: 3.7 feet DATE GWL CHECKED: 08-23-90
BORING METHOD: Rotary drill w/ drill mud and casing FLUID LOSS: 25 feet

ELEV. / DEPTH	SOIL SYMBOLS AND FIELD TEST DATA	MAJOR SOIL COMPONENT	OTHER COMPONENTS
-20 / 30	3/6, 2/6, 5/6		Loose, gray-tan, shelly, with some sandstone fragments.
-25 / 35	9/6, 14/6, 17/6		Dense, light gray, with trace of sandstone fragments.
-30 / 40	7/6, 4/6, 5/6		Loose, tan, with some sandstone fragments.
-35 / 45	8/6, 10/6, 10/6		Firm, light tan, with trace of sandstone fragments.
-40 / 50	15/6, 7/6, 8/6		Firm, tan, with trace of sandstone fragments.



Refer to Notes and Legend on separate sheet for aditional information.
This Record of Test Boring is part of the project Geotechnical Report.
Soil samples collected using ASTM D-1586 test procedures. Rock core samples collected using ASTM D-2113 test procedures.

KBC CONSULTANTS, INC.

RECORD OF TEST BORING

PROJECT/LOCATION: Hollywood WWTP / Broward County, FL BORING NO: B-5
PROJECT NO: 88163A START: 08-24-90 FINISH: 08-24-90 WEATHER: Sunny/Hot
BORING LOCATION: See Test Location Drawing DRILLER: W. Wallace
DRILL: Mobile B-80 DRILL CONTRACTOR: KBC Inspection and Testing, Inc.
ELEV.: +5.5 feet NGVD GROUNDWATER: 3.7 feet DATE GWL CHECKED: 08-24-90
BORING METHOD: Rotary drill w/ drill mud and casing FLUID LOSS: 27 feet

ELEV. / DEPTH	SOIL SYMBOLS AND FIELD TEST DATA	MAJOR SOIL COMPONENT	OTHER COMPONENTS
5 / 0	9/6, 10/6, 8/6	FINE GRAVEL AND SAND	Firm, brown, silty.
0 / 5	2/6, 1/6, 1/6	SAND	Soft, brown, with some snad and trace of lime-stone fragments.
-5 / 10	1/6, 1/6, 0/6		Very soft, brown, with some sand.
-5 / 10	6/6, 8/6, 11/6	FINE GRAVEL (MIAMI LIMESTONE)	Firm, light tan, with some sand.
-10 / 15	8/6, 7/6, 7/6		Firm, light tan, with some sand.
-15 / 20	13/6, 10/6, 6/6		Firm, light tan, with some sand.
-20 / 25	12/6, 47/6, 13/6	HARD LIMESTONE (SPT N-VALUE > 50)	Dense, orange-tan, with trace of sand.

Boring Continues

Water Checked 08-24-90

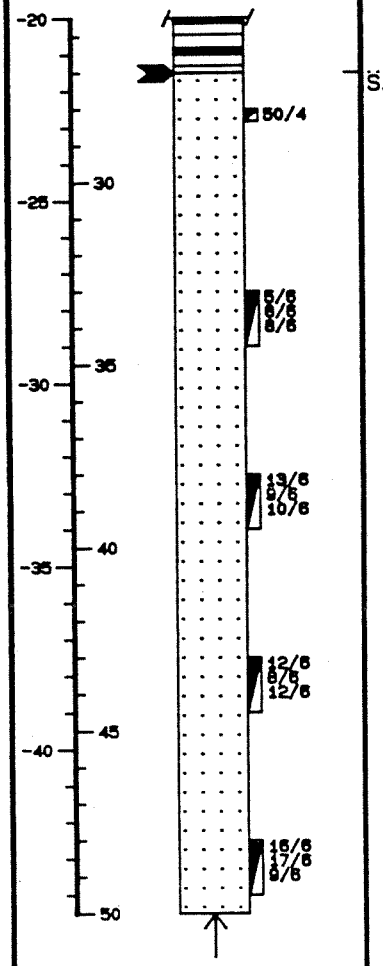
Refer to Notes and Legend on separate sheet for additional information.
This Record of Test Boring is aprt of the project Geotechnical Report.

Soil samples collected using ASTM D-1586 test procedures. Rock core samples collected using ASTM D-2113 test procedures.

KBC CONSULTANTS, INC.

RECORD OF TEST BORING

PROJECT/LOCATION: Hollywood WWTP / Broward County, FL BORING NO: B-5
PROJECT NO: 88163A START: 08-24-90 FINISH: 08-24-90 WEATHER: Sunny/Hot
BORING LOCATION: See Test Location Drawing DRILLER: W. Wallace
DRILL: Mobile B-80 DRILL CONTRACTOR: KBC Inspection and Testing, Inc.
ELEV.: +5.5 feet NGVD GROUNDWATER: 3.7 feet DATE GWL CHECKED: 08-24-90
BORING METHOD: Rotary drill w/ drill mud and casing FLUID LOSS: 27 feet

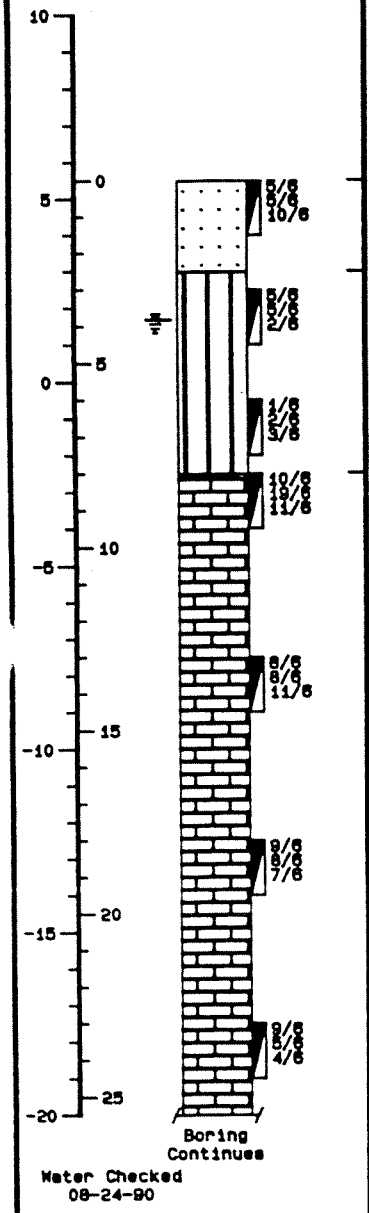
ELEV. / DEPTH	SOIL SYMBOLS AND FIELD TEST DATA	MAJOR SOIL COMPONENT	OTHER COMPONENTS
-20 / 30		SAND	Dense, gray, shelly.
			Firm, gray, slightly shelly.
			Firm, gray, slightly shelly.
			Firm, gray, slightly shelly.
			Very firm, gray, slightly shelly.

Refer to Notes and Legend on separate sheet for additional information.
This Record of Test Boring is aprt of the project Geotechnical Report.
Soil samples collected using ASTM D-1586 test procedures. Rock core samples collected using ASTM D-2113 test procedures.

KBC CONSULTANTS, INC.

RECORD OF TEST BORING

PROJECT/LOCATION: Hollywood WWTP / Broward County, FL BORING NO: B-6
PROJECT NO: 88163A START: 08-24-90 FINISH: 08-24-90 WEATHER: Sunny/Hot
BORING LOCATION: See Test Location Drawing DRILLER: W. Wallace
DRILL: Mobile B-80 DRILL CONTRACTOR: KBC Inspection and Testing, Inc.
ELEV.: +5.5 feet NGVD GROUNDWATER: 3.8 feet DATE GWL CHECKED: 08-24-90
BORING METHOD: Rotary drill w/ drill mud and casing FLUID LOSS: 27 feet



MAJOR SOIL COMPONENT	OTHER COMPONENTS
SAND	Firm, brown, silty, with trace of limestone fragments.
SILT	Firm, gray-brown, with some sand.
	Firm, gray-brown, with some sand.
FINE GRAVEL (MIAMI LIMESTONE)	Very firm, light tan, with trace of sand.
	Firm, light tan, with trace of sand.
	Firm, light tan, with trace of sand.
	Loose, gray-tan, with some sand.

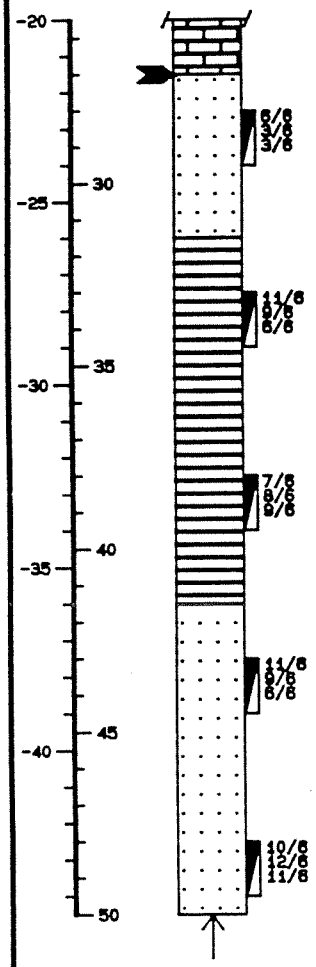
Refer to Notes and Legend on separate sheet for additional information.
This Record of Test Boring is part of the project Geotechnical Report.

Soil samples collected using ASTM D-1586 test procedures. Rock core samples collected using ASTM D-2113 test procedures.

KBC CONSULTANTS, INC.

RECORD OF TEST BORING

PROJECT/LOCATION: Hollywood WWTP / Broward County, FL BORING NO: B-6
PROJECT NO: 88163A START: 08-24-90 FINISH: 08-24-90 WEATHER: Sunny/Hot
BORING LOCATION: See Test Location Drawing DRILLER: W. Wallace
DRILL: Mobile B-80 DRILL CONTRACTOR: KBC Inspection and Testing, Inc.
ELEV.: +5.5 feet NGVD GROUNDWATER: 3.8 feet DATE GWL CHECKED: 08-24-90
BORING METHOD: Rotary drill w/ drill mud and casing FLUID LOSS: 27 feet

ELEV. / DEPTH	SOIL SYMBOLS AND FIELD TEST DATA	MAJOR SOIL COMPONENT	OTHER COMPONENTS
-20 / 30		SAND	Loose, gray-tan shelly.
-25 / 35		FINE GRAVEL (FORT THOMPSON LIMESTONE)	Firm, gray/brown, with some sand.
-30 / 40			Firm, gray-tan, with some sand.
-35 / 45		SAND	Firm, gray-tan, shelly, with trace of sandstone fragments.
-40 / 50			Very firm, gray-tan, shelly, with trace of sandstone fragments.

Refer to Notes and Legend on separate sheet for additional information.
This Record of Test Boring is part of the project Geotechnical Report.
Soil samples collected using ASTM D-1586 test procedures. Rock core samples collected using ASTM D-2113 test procedures.

KBC CONSULTANTS, INC.

RECORD OF TEST BORING

PROJECT/LOCATION: Hollywood WWTP / Broward County, FL BORING NO: B-7
PROJECT NO: 88163A START: 08-24-90 FINISH: 08-24-90 WEATHER: Sunny/Hot
BORING LOCATION: See Test Location Drawing DRILLER: W. Wallace
DRILL: Mobile B-80 DRILL CONTRACTOR: KBC Inspection and Testing, Inc.
ELEV.: +5.5 feet NGVD GROUNDWATER: 3.9 feet DATE GWL CHECKED: 08-24-90
BORING METHOD: Rotary drill w/ drill mud and casing FLUID LOSS: 29 feet

ELEV. / DEPTH	SOIL SYMBOLS AND FIELD TEST DATA	MAJOR SOIL COMPONENT	OTHER COMPONENTS
5 / 0	3/6, 3/6, 3/6	SAND	Loose, brown, silty, with some wood fragments.
0 / 5	3/6, 4/6, 4/6	SILT	Firm, orange-brown, with some sand.
-5 / 10	2/6, 3/6, 5/6		Firm, gray, with some sand.
-10 / 15	6/6, 3/6, 8/6	FINE GRAVEL (MIAMI LIMESTONE)	Loose, tan, with some sand.
	12/6, 9/6, 8/6		Firm, tan, with trace of sand.
-15 / 20	7/6, 4/6, 5/6		Loose, tan, with trace of sand.
-20 / 25	5/6, 2/6, 4/6		Loose, tan, shelly, with some sand.

Boring Continues

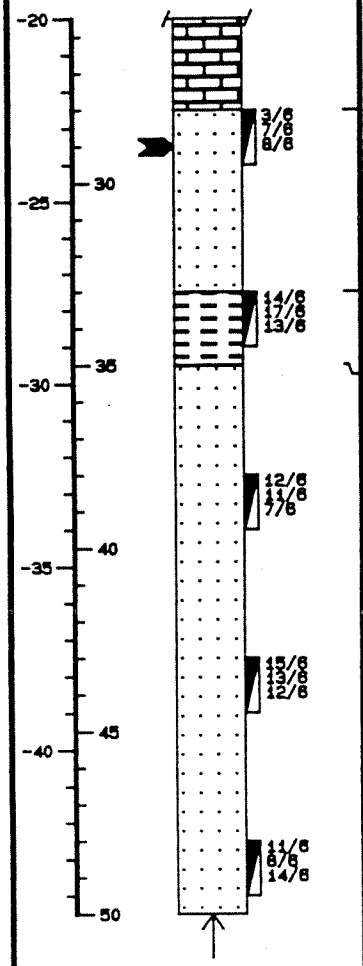
Water Checked 08-24-90

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Soil samples collected using ASTM D-1586 test procedures. Rock core samples collected using ASTM D-2113 test procedures.

RECORD OF TEST BORING

PROJECT/LOCATION: Hollywood WWTP / Broward County, FL BORING NO: B-7
PROJECT NO: 88163A START: 08-24-90 FINISH: 08-24-90 WEATHER: Sunny/Hot
BORING LOCATION: See Test Location Drawing DRILLER: W. Wallace
DRILL: Mobile B-80 DRILL CONTRACTOR: KBC Inspection and Testing, Inc.
ELEV.: +5.5 feet NGVD GROUNDWATER: 3.9 feet DATE GWL CHECKED: 08-24-90
BORING METHOD: Rotary drill w/ drill mud and casing FLUID LOSS: 29 feet

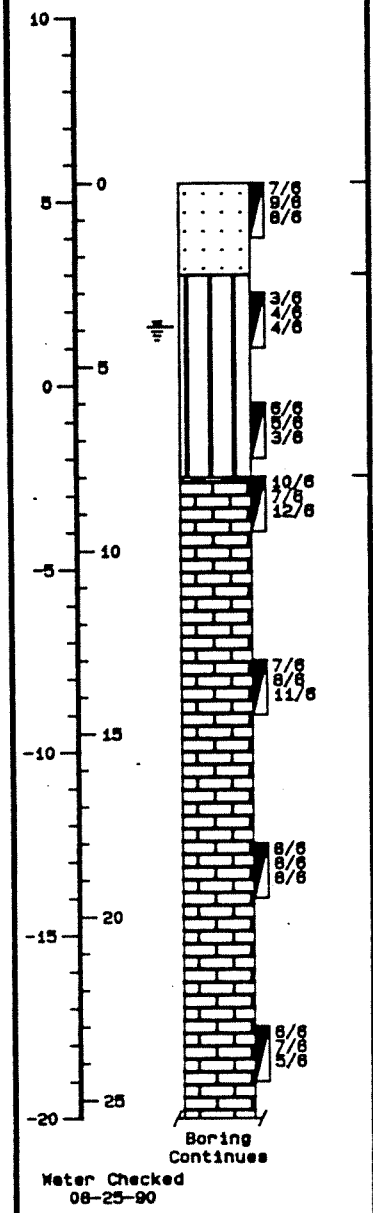
ELEV. / DEPTH	SOIL SYMBOLS AND FIELD TEST DATA	MAJOR SOIL COMPONENT	OTHER COMPONENTS
-20 / 30		SAND	Firm, greenish-gray, with trace of sandstone fragments.
-25 / 35		FINE GRAVEL (FORT THOMPSON SANDSTONE)	Very firm, gray-brown, with trace of sand.
-30		SAND	Firm, gray-tan, with some sandstone fragments.
-35 / 40			
-40 / 45			Very firm, gray-tan, with trace of sandstone fragments.
50			Very firm, gray-tan, with some sandstone fragments.

Refer to Notes and Legend on separate sheet for additional information.
This Record of Test Boring is part of the project Geotechnical Report.
Soil samples collected using ASTM D-1586 test procedures. Rock core samples collected using ASTM D-2113 test procedures.

KBC CONSULTANTS, INC.

RECORD OF TEST BORING

PROJECT/LOCATION: Hollywood WWTP / Broward County, FL BORING NO: B-8
PROJECT NO: 88163A START: 08-25-90 FINISH: 08-25-90 WEATHER: Sunny/Hot
BORING LOCATION: See Test Location Drawing DRILLER: W. Wallace
DRILL: Mobile B-80 DRILL CONTRACTOR: KBC Inspection and Testing, Inc.
ELEV.: +5.5 feet NGVD GROUNDWATER: 3.9 feet DATE GWL CHECKED: 08-25-90
BORING METHOD: Rotary drill w/ drill mud and casing FLUID LOSS: 27 feet



MAJOR SOIL COMPONENT	OTHER COMPONENTS
SAND	Firm, brown, silty.
SILT	Firm, gray-black, with some sand.
	Firm, gray, with trace of sand.
FINE GRAVEL (MIAMI LIMESTONE)	Firm, gray-tan, with some sand.
	Firm, gray-tan, with trace of sand.
	Firm, light gray-tan, with trace of sand.
	Firm, gray-tan, with trace of sand.

Refer to Notes and Legend on separate sheet for additional information.
This Record of Test Boring is part of the project Geotechnical Report.

Soil samples collected using ASTM D-1586 test procedures. Rock core samples collected using ASTM D-2113 test procedures.

KBC CONSULTANTS, INC.

RECORD OF TEST BORING

PROJECT/LOCATION: Hollywood WWTP / Broward County, FL BORING NO: B-8
PROJECT NO: 88163A START: 08-25-90 FINISH: 08-25-90 WEATHER: Sunny/Hot
BORING LOCATION: See Test Location Drawing DRILLER: W. Wallace
DRILL: Mobile B-80 DRILL CONTRACTOR: KBC Inspection and Testing, Inc.
ELEV.: +5.5 feet NGVD GROUNDWATER: 3.9 feet DATE GWL CHECKED: 08-25-90
BORING METHOD: Rotary drill w/ drill mud and casing FLUID LOSS: 27 feet

ELEV. / DEPTH	SOIL SYMBOLS AND FIELD TEST DATA	MAJOR SOIL COMPONENT	OTHER COMPONENTS
-20 / 30 / -25 / 35 / -30 / 40 / -35 / 45 / -40 / 50	37/6 50/5	SAND	Dense, gray-tan.
	7/6 6/6 5/6		Firm, gray-tan.
	14/6 12/6 11/6		Very firm, gray-tan, with trace of sandstone fragments.
	9/6 7/6 8/6		Firm, greenish-gray, with trace of sandstone fragments.
	7/6 12/6 11/6		Very firm, greenish-gray, with trace of sandstone fragments.

Refer to Notes and Legend on separate sheet for additional information.
This Record of Test Boring is part of the project Geotechnical Report.

Soil samples collected using ASTM D-1586 test procedures. Rock core samples collected using ASTM D-2113 test procedures.

KBC CONSULTANTS, INC.

RECORD OF TEST EXCAVATIONS

HOLLYWOOD WASTE WATER TREATMENT PLANT

KBC Consultants, Inc.
KBC Project No. 88163A

Test Excavation number: TE - 1

Date of excavation: 08-27-90

Ground surface elevation, feet NGVD: +5.5

Termination depth, feet: 10

Plan dimensions, feet: 2 x 8

Depth below ground surface, feet	Soil / Rock Description
0 - 0.5	Dark brown fine to medium grained SAND with roots (Topsoil).
0.5 - 2.5	Gray-tan fine to medium grained SAND and fine gravel sized LIMESTONE FRAGMENTS.
2.5 - 5.5	Gray fine grained SAND AND SILT with trace of fine gravel sized limestone fragments.
5.5 - 8.0	Gray SILT with some fine grained sand.
8.0 - 9.0	Light tan LIMESTONE.

NOTES:

1. Groundwater seepage was judged to be slow at this location.
2. A pump test was performed within this test excavation. The stabilized groundwater level was about 4 feet below ground surface. The groundwater was lowered to 10 feet below grade in about 2 minutes pumping at a rate of about 55 gpm. Next, the pump was removed from the excavation and the water was allowed to recharge the excavation. The water level rose from a depth of 9.7 feet to 9.3 feet over a time interval of 4 minutes, 10 seconds.

RECORD OF TEST EXCAVATIONS

HOLLYWOOD WASTE WATER TREATMENT PLANT

KBC Consultants, Inc.
KBC Project No. 88163A

Test Excavation number:	TE - 2
Date of excavation:	08-27-90
Ground surface elevation, feet NGVD:	+5.5
Termination depth, feet:	8.5
Plan dimensions, feet:	2 x 8

Depth below ground surface, feet	Soil / Rock Description
0 - 4	Dark brown fine to medium grained SAND with concrete boulders, slab fragments, bricks, rebars and sections of pipe.
4 - 6.7	Dark brown-black SILT with some peat and fine grained sand.
6.7 - 8.5	Light tan LIMESTONE.

NOTES:

Seepage of groundwater into trench was judged to be slow. A stabililzed groundwater level could not be determined.

RECORD OF TEST EXCAVATIONS

HOLLYWOOD WASTE WATER TREATMENT PLANT

KBC Consultants, Inc.
KBC Project No. 88163A

Test Excavation number:	TE - 3
Date of excavation:	08-27-90
Ground surface elevation, feet NGVD:	+6.0
Termination depth, feet:	8.5
Plan dimensions, feet:	4 x 8

Depth below ground surface, feet	Soil / Rock Description
0 - 1.0	Light tan medium to fine grained SAND with trace of fine gravel limestone fragments.
1.0 - 1.5	Light gray medium to fine grained SAND with some concrete fragments.
1.5 - 4.0	Dark gray-brown fine gravel sized limestone fragments with some silt, peat and concrete fragments.
4.0 - 6.0	Light gray concrete fragments with some sand.
6.0 - 8.5	Dark gray-brown fine gravel sized limestone fragments with some silt, peat and concrete fragments.

NOTES:

Seepage of groundwater into trench was judged to be fast. Static groundwater level is approximately 4' below grade.

RECORD OF TEST EXCAVATIONS

HOLLYWOOD WASTE WATER TREATMENT PLANT

KBC Consultants, Inc.
KBC Project No. 88163A

Test Excavation number:	TE - 4
Date of excavation:	08-27-90
Ground surface elevation, feet NGVD:	+6.0
Termination depth, feet:	8.5
Plan dimensions, feet:	2 x 8

Depth below ground surface, feet	Soil / Rock Description
0 - 1	Light tan fine to medium grained SAND and fine gravel sized LIMESTONE FRAGMENTS.
1 - 8.5	Gray-black fine gravel sized LIMESTONE FRAGMENTS, SILT and fine SAND.

NOTES:

Seepage of groundwater into trench was judged to be fast. Static groundwater level is approximately 4' below grade.

RECORD OF TEST EXCAVATIONS

HOLLYWOOD WASTE WATER TREATMENT PLANT

KBC Consultants, Inc.
KBC Project No. 88163A

Test Excavation number:	TE - 5
Date of excavation:	08-27-90
Ground surface elevation, feet NGVD:	+5.5
Termination depth, feet:	9.0
Plan dimensions, feet:	2 x 8

Depth below ground surface, feet	Soil / Rock Description
0 - 0.5	Dark brown medium to fine grained SAND with some limestone fragments.
0.5 - 1.5	Reddish brown medium to fine grained SAND with some limestone fragments.
1.5 - 3.0	Gray medium to fine grained SAND and fine gravel sized LIMESTONE FRAGMENTS.
3.0 - 8.0	Yellow gray to gray SILT with some sand and mangrove roots.
8.0 - 9.0	Light tan LIMESTONE.

NOTES:

Seepage of groundwater into trench was judged to be slow. Static groundwater level could not be determined.

RECORD OF TEST EXCAVATIONS

HOLLYWOOD WASTE WATER TREATMENT PLANT

KBC Consultants, Inc.
KBC Project No. 88163A

Test Excavation number:	TE - 6
Date of excavation:	08-27-90
Ground surface elevation, feet NGVD:	+5.5
Termination depth, feet:	9.0
Plan dimensions, feet:	2 x 8

Depth below ground surface, feet	Soil / Rock Description
0 - 1	Brown medium to fine grained SAND with some limestone fragments.
1 - 2	Reddish brown medium to fine grained SAND with some limestone fragments.
2 - 2.5	Gray medium to fine grained SAND and fine gravel sized LIMESTONE FRAGMENTS. A 1" diameter steel pipe was found in this layer.
2.5 - 8.0	Yellow gray to gray SILT with some sand and mangrove roots.
8.0 - 9.0	Light tan LIMESTONE.

NOTES:

Seepage of groundwater into trench was judged to be slow. Static groundwater level could not be determined.

RECORD OF TEST EXCAVATIONS

HOLLYWOOD WASTE WATER TREATMENT PLANT

KBC Consultants, Inc.
KBC Project No. 88163A

Test Excavation number:	TE - 7
Date of excavation:	08-27-90
Ground surface elevation, feet NGVD:	+5.5
Termination depth, feet:	9.0
Plan dimensions, feet:	2 x 8

Depth below ground surface, feet	Soil / Rock Description
0 - 2.5	Light brown-gray fine to medium grained SAND with some fine gravel sized limestone fragments.
2.5 - 4.5	Orange-brown fine to medium grained SAND with trace of fine gravel sized limestone fragments.
4.5 - 8.0	Gray SILT and fine grained SAND with some sand and mangrove roots.
8.0 - 9.0	Light tan LIMESTONE.

NOTES:

Seepage of groundwater into trench was judged to be slow. Static groundwater level could not be determined.

RECORD OF TEST EXCAVATIONS

HOLLYWOOD WASTE WATER TREATMENT PLANT

KBC Consultants, Inc.
KBC Project No. 88163A

Test Excavation number:	TE - 8
Date of excavation:	08-27-90
Ground surface elevation, feet NGVD:	+6.0
Termination depth, feet:	9.0
Plan dimensions, feet:	2 x 8

Depth below ground surface, feet	Soil / Rock Description
0 - 1	Light brown fine to medium grained SAND and fine gravel sized LIMESTONE FRAGMENTS.
1 - 3	Dark black slightly silty fine grained SAND with organic odor.
3 - 8.5	Gray-black fine grained sand and silt with organic odor.
8.5 - 9.0	Light tan LIMESTONE.

NOTES:

Seepage of groundwater into trench was judged to be fast. Static groundwater level is approximately 4.5' below grade.

RECORD OF TEST EXCAVATIONS

HOLLYWOOD WASTE WATER TREATMENT PLANT

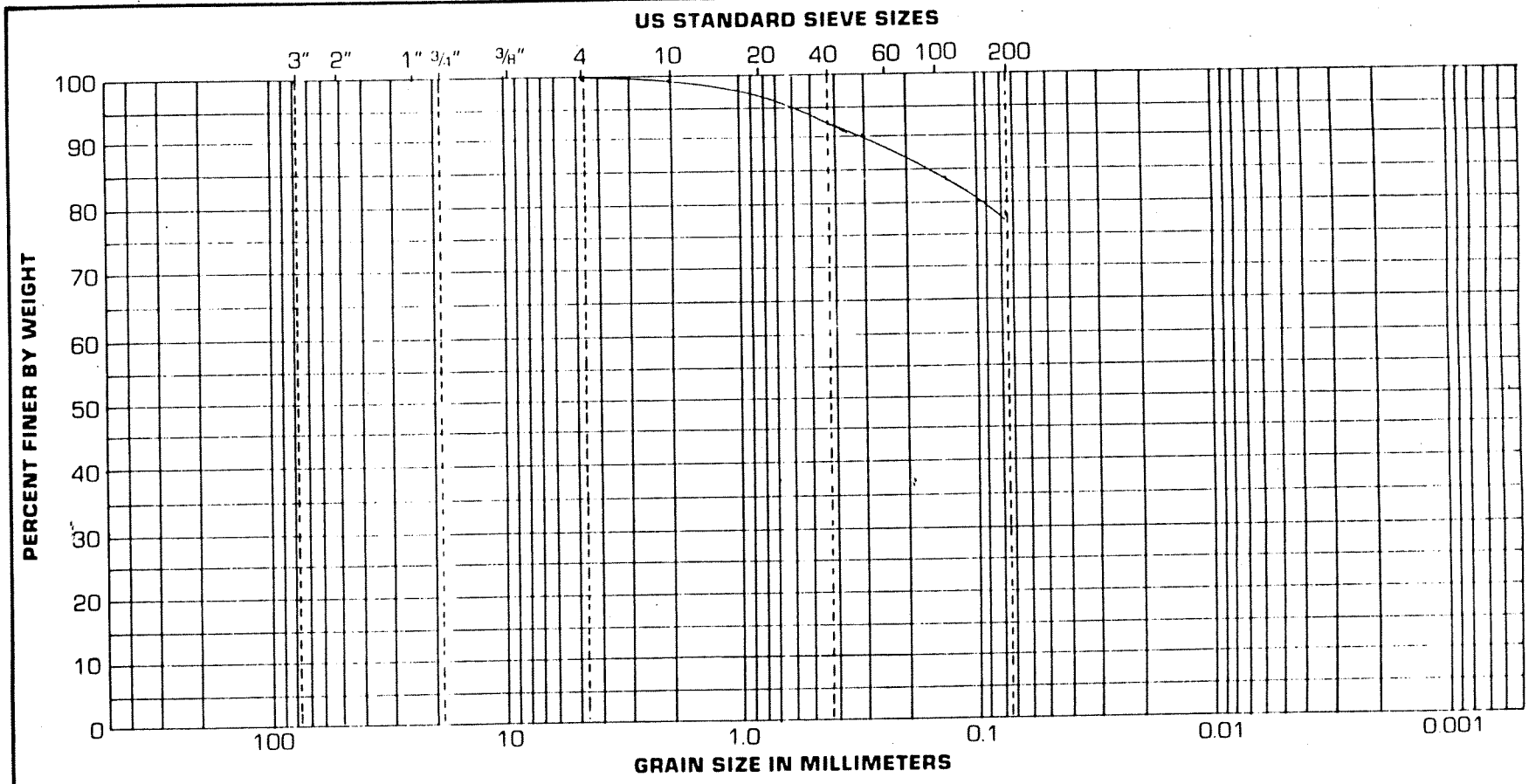
KBC Consultants, Inc.
KBC Project No. 88163A

Test Excavation number:	TE - 9
Date of excavation:	08-27-90
Ground surface elevation, feet NGVD:	+6.0
Termination depth, feet:	9.0
Plan dimensions, feet:	2 x 8

Depth below ground surface, feet	Soil / Rock Description
0 - 1.5	Light brown fine to medium grained SAND and fine gravel sized LIMESTONE FRAGMENTS.
1.5 - 3	Dark brown slightly silty fine grained SAND with trace of fine gravel sized limestone fragments.
3 - 8.5	Gray-brown SILT with some fine grained sand.
8.5 - 9.0	Light tan LIMESTONE.

NOTES:

Seepage of groundwater into trench was judged to be slow. Static groundwater level could not be determined.

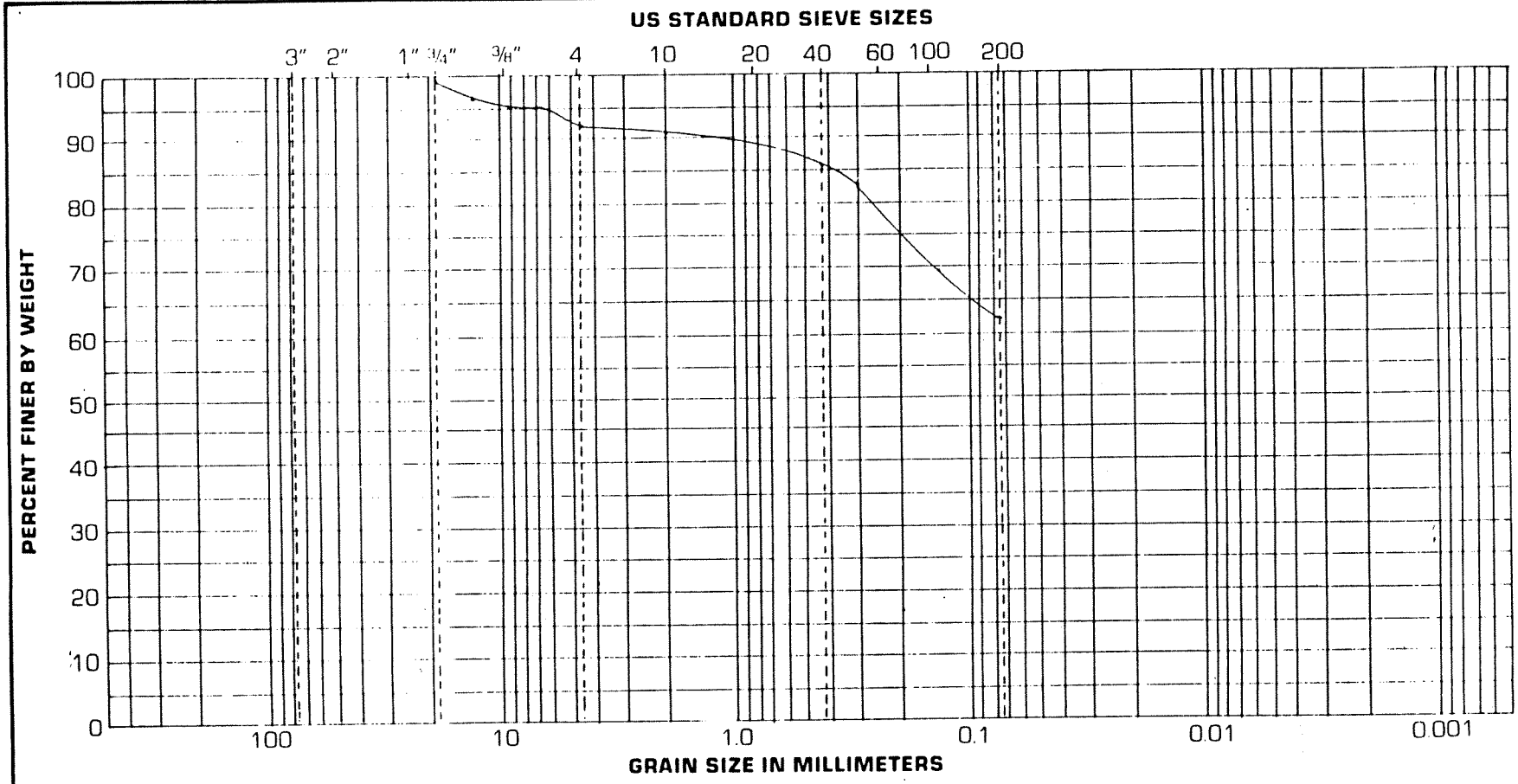


BORING NO	ELEV OR DEPTH	NAT WC	LL	PL	PI	DESCRIPTION OR CLASSIFICATION
TE-2		133	N/A	N/A	N/A	Black SILT with some fine to medium Sand and Peat.

GRAIN SIZE DISTRIBUTION

PROJECT NO. 88163A

KBC CONSULTANTS, INC.

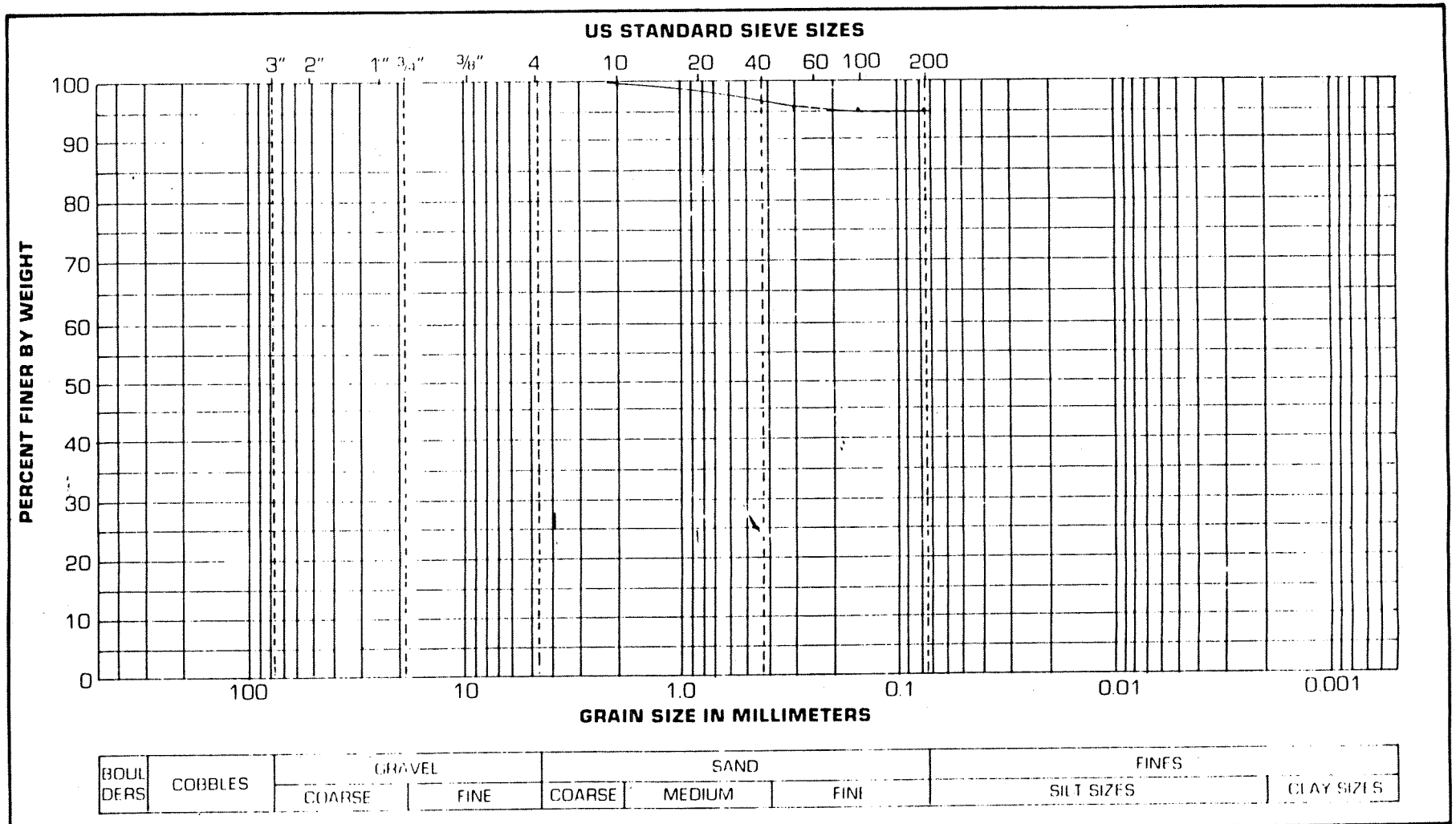


BORING NO	ELEV OR DEPTH	NAT WC	LL	PL	PI	DESCRIPTION OR CLASSIFICATION
TE-3		66	N / A	N / A	N / A	Dark brown SILT and fine to medium SAND with a trace if fine gravel sized limerock and shell.

GRAIN SIZE DISTRIBUTION

PROJECT NO. 88163A

KBC CONSULTANTS, INC.

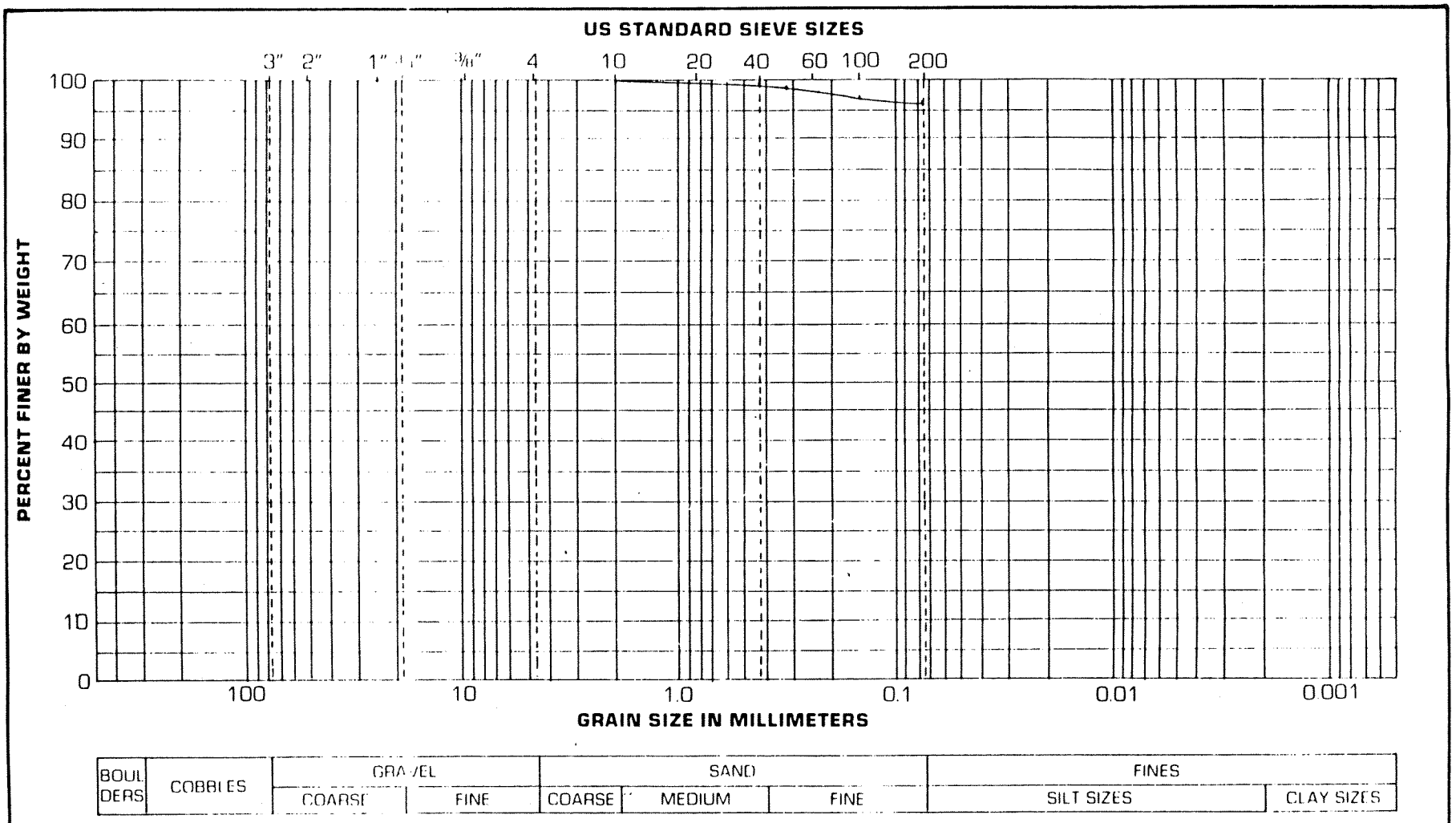


BORING NO	ELEV OR DEPTH	NAT WC	LL	PL	PI	DESCRIPTION OR CLASSIFICATION
TE-5A		57	N/A	N/A	N/A	Light brown/brown SILT with a trace of fine Sand.

GRAIN SIZE DISTRIBUTION

PROJECT NO 88163A

KBC CONSULTANTS, INC.

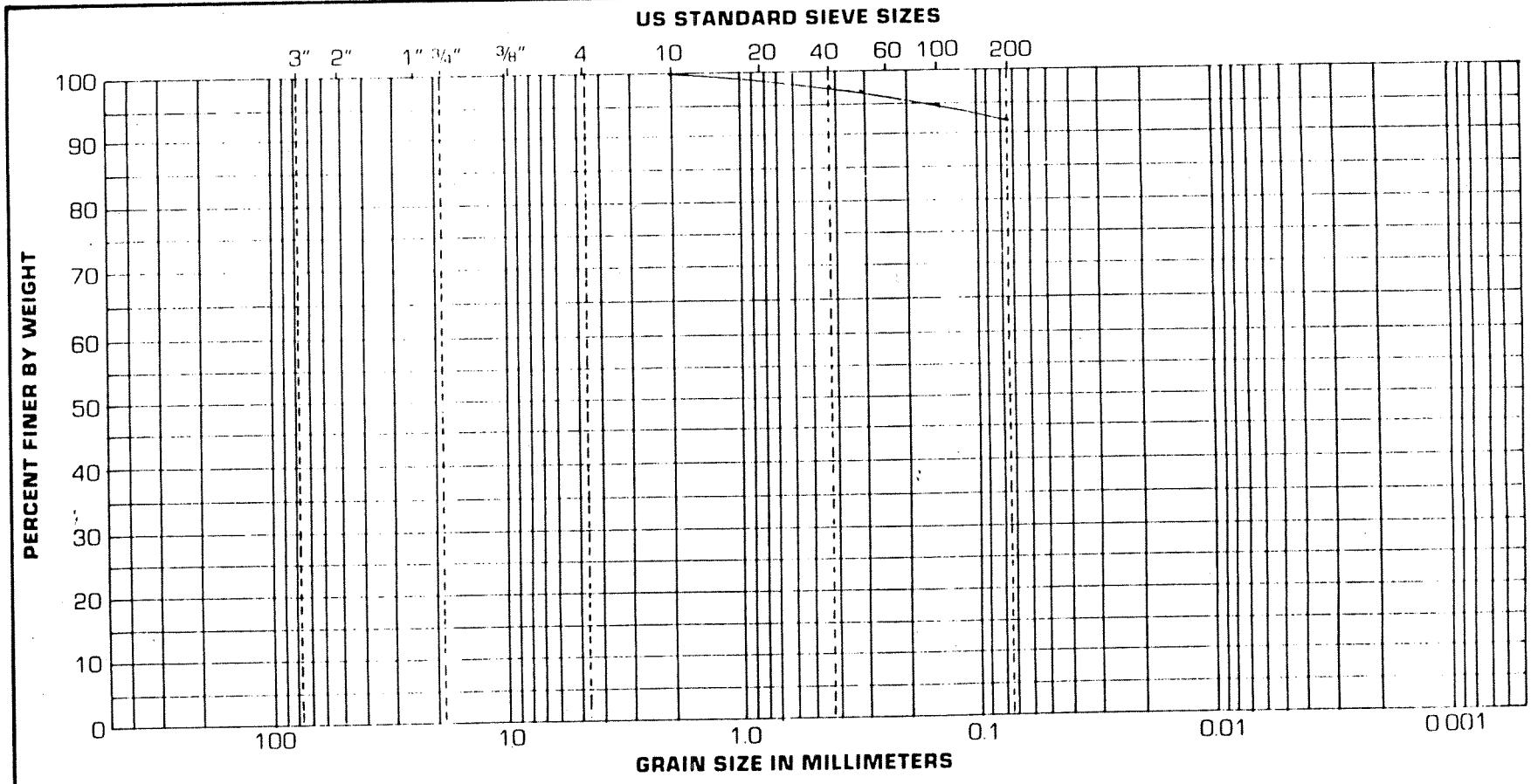


BORING NO	ELEV OR DEPTH	NAT WC	LL	PL	PI	DESCRIPTION OR CLASSIFICATION
TE-5B		64	N/A	N/A	N/A	Light brown/brown SILT with a trace of fine sand.

GRAIN SIZE DISTRIBUTION

PROJECT NO. 88163A

KBC CONSULTANTS, INC.



BORING NO	ELEV OR DEPTH	NAT WC	LL	PL	PI	DESCRIPTION OR CLASSIFICATION
TE-7		107	N/A	N/A	N/A	Dark brown SILT with trace of fine sand.

GRAIN SIZE DISTRIBUTION

PROJECT NO. 88163A

KBC CONSULTANTS, INC.

RESULTS OF FIELD PUMPING TEST

HOLLYWOOD WASTEWATER TREATMENT PLANT
KBC PROJECT NO. 88163

TEST DATE: 3-21-89

TEST LOCATION: South edge of clarifier No. 7

GROUND SURFACE ELEVATION: +3.7 feet NGVD

GROUNDWATER ELEVATION: +0.0 feet NGVD (before pumping)

EXCAVATION AREA IN PLAN VIEW: 16 X 1.5 feet

AVERAGE EXCAVATION DEPTH: 14.2 feet (5 measurements)

SUBSURFACE CONDITIONS:

Elevation Range, feet, NGVD	Description
+3.7 to +0.7	Brown, medium sand with trace of fine gravel sized limestone fragments (fill).
+0.7 to -1.8	Brown black sandy silt with peat zones, with some fine roots.
-1.8 to -10.5	Tan cemented calcareous sandy porous limestone (Miami Limestone formation).

METHOD OF PUMP DISCHARGE CALIBRATION: Container with known volume, stopwatch

PUMP TYPE AND SIZE: 4-inch suction pump, 400 gpm capacity

PUMPING TEST DATA:

Time	GWL Elev. feet, NGVD	Time	GWL Elev. feet, NGVD
12:53PM	-0.15	1:10 PM	-4.60
12:54	-0.55	1:11	-
12:55	-1.05	1:12	-
12:56	-1.45	1:13	-4.70
12:57	-1.95	1:14	-4.80
12:58	-2.45	1:15	-
12:59	-2.75	1:16	-5.00
1:00	-3.05	1:17	-
1:01	-3.35	1:18	-5.05
1:02	-3.55	1:19	-5.15
1:03	-3.75	1:20	-5.25
1:04	-3.95	1:21	-5.30
1:05	-4.05	1:22	-
1:06	-4.25	1:23	-5.40
1:07	-	1:24	-
1:08	-4.45	1:25	-5.5
1:09	-4.55	1:30	-5.6

PUMPING TEST GWL RECOVERY DATA (No pumping):

Time	GWL Elev. feet, NGVD	Time	GWL Elev. feet, NGVD
1:45 PM	-8.20	1:50	-2.90
1:47	-5.40	1:51	-2.40
1:48	-4.20	1:52	-1.90
1:49	-3.50		

NOTES RELATED TO PUMPING TEST:

1. Excavation performed with hydraulic combination backhoe.
2. Backhoe operator termed excavation "difficult" when digging in the limestone strata. Excavation process took about one hour.
3. Excavation remained vertical over entire depth of excavation.
4. Pump discharge estimated to be 143 gpm at 12:58 PM.
5. Pump discharge estimated to be 132 gpm at 1:16 PM.
6. Pump speed increased over time interval 1:35 PM to 1:45 PM and maximum GWL drawdown was recorded to be -8.2 feet NGVD.
7. Hydraulic conductivity estimated using the formula:

$$S_c = \frac{Q}{(L)\ (W)\ (H)}$$

S_c = Hydraulic conductivity cfs/ft^2/ft. head
Q = Pump discharge, cfs
L = Trench length, feet
W = Trench width, feet
H = Head or drawdown, feet

8. Hydraulic conductivity estimated at time 1:16 PM to be 0.0025 cfs/ft^2/foot hydraulic head.

CITY OF HOLLYWOOD
DEPARTMENT OF PUBLIC UTILITIES
ENGINEERING & CONSTRUCTION SERVICES DIVISION

1621 N. 14th Avenue
Hollywood, FL 33019
Phone (954) 921-3930 Fax (954) 921-3258

SRWWTP TEMPORARY SODIUM HYPOCHLORITE SYSTEM
Addendum No. 3

Date: March 18, 2026

Solicitation Number: REQ-373-26-JJ

Project Number: 24-9122

ALL BIDDERS BE ADVISED OF THE FOLLOWING CHANGES TO THE ABOVE REFERENCED PROJECT AS LISTED BELOW:

This addendum is issued as part of the Bidding Documents for the above described project. The changes incorporated in this addendum shall be considered as a part of the documents and shall supersede, amend, add to, clarify, or subtract from those conditions shown in the original documents. The bidder shall coordinate all modifications herein with all trades and disciplines related to the work. The Bidder shall acknowledge receipt of this addendum on the Bid Form by addendum number and date. Failure to do so may subject Bidder to disqualification.

Item 1: Technical Specifications

A. **Existing Specification Changes.** The following existing Sections are replaced in their entirety and issued as part of this Addendum:

1. Section 00 01 10 - Table of Contents
2. Section 01 11 00 - Summary of Work
3. Section 01 14 00 - Coordination With Owner's Operations
4. Section 40 05 25.63 - Check Valves
5. Section 40 06 20 - Process Pipe, Valves, and Gate Schedules
6. Section 40 61 91A - Process Control System Instrument List
7. Section 40 61 93A - Process Control System Input-Output List
8. Section 40 61 96 - Process Control Descriptions
9. Section 46 41 42 - Chemical Injection Assemblies

B. **New Specification Sections**. The following new Specifications Section is added and issued as part of this Addendum

1. Section 40 71 43 - Variable Area Flow Meters

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SRWWTP TEMPORARY SODIUM HYPOCHLORITE SYSTEM
Addendum No. 3

Item 2: Technical Drawings

A. Drawing G-01:

1. Replace the existing Drawing G-01 with the attached.

B. Drawing C-01:

1. Replace the existing Drawing C-01 with the attached.

C. Drawing C-02:

1. Replace the existing Drawing C-02 with the attached.

D. Drawing C-03:

1. Replace the existing Drawing C-03 with the attached.

E. Drawing C-04:

1. Replace the existing Drawing C-04 with the attached.

F. Drawing C-07:

1. Replace the existing Drawing C-07 with the attached.

G. Drawing C-08:

1. Replace the existing Drawing C-08 with the attached.

H. Drawing M-01:

1. Replace the existing Drawing M-01 with the attached.

I. Drawing M-02:

1. Replace the existing Drawing M-02 with the attached.

J. Drawing M-03:

1. Replace the existing Drawing M-03 with the attached.

CITY OF HOLLYWOOD
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SRWWTP TEMPORARY SODIUM HYPOCHLORITE SYSTEM
Addendum No. 3

K. Drawing M-04:

1. Replace the existing Drawing M-04 with the attached.

L. Drawing M-05:

1. Replace the existing Drawing M-05 with the attached.

M. Drawing M-06:

1. Replace the existing Drawing M-06 with the attached.

N. Drawing M-07:

1. Replace the existing Drawing M-07 with the attached.

O. Drawing M-08:

1. Replace the existing Drawing M-08 with the attached.

P. Drawing M-09:

1. Replace the existing Drawing M-09 with the attached.

Q. Drawing M-13:

1. Replace the existing Drawing M-13 with the attached.

R. Drawing M-14:

1. Replace the existing Drawing M-14 with the attached.

S. Drawing M-16:

1. Replace the existing Drawing M-16 with the attached.

T. Drawing M-17:

1. Replace the existing Drawing M-17 with the attached.

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SRWWTP TEMPORARY SODIUM HYPOCHLORITE SYSTEM
Addendum No. 3

U. Drawing S-09:

1. Replace the existing Drawing S-09 with the attached.

V. Drawing S-10:

1. Replace the existing Drawing S-10 with the attached.

W. Drawing I-03:

1. Replace the existing Drawing I-03 with the attached.

X. Drawing I-04:

1. Replace the existing Drawing I-04 with the attached.

Y. Drawing I-05:

1. Replace the existing Drawing I-05 with the attached.

Z. Drawing I-06:

1. Replace the existing Drawing I-06 with the attached.

AA. Drawing I-07:

1. Replace the existing Drawing I-07 with the attached.

BB. Drawing I-08:

1. Replace the existing Drawing I-08 with the attached.

CC. Drawing I-11:

1. Replace the existing Drawing I-11 with the attached.

DD. Drawing E-03:

1. Replace the existing Drawing E-03 with the attached.

CITY OF HOLLYWOOD
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Addendum No. 3

EE. Drawing E-05:

1. Replace the existing Drawing E-05 with the attached.

FF. Drawing E-07:

1. Replace the existing Drawing E-07 with the attached.

ALL OTHER TERMS, CONDITIONS AND SPECIFICATIONS SHALL REMAIN THE SAME.

THIS ADDENDUM SHALL BE ATTACHED TO THE CONTRACT DOCUMENTS AND THE RECEIPT OF THE SAME SHALL BE NOTED IN THE PROPOSAL IN THE SPACE PROVIDED.

END ADDENDUM NO. 3

CITY OF HOLLYWOOD
SOUTHERN REGIONAL WASTEWATER TREATMENT PLANT

CONTRACT DOCUMENTS
TEMPORARY HYPOCHLORITE SYSTEM
CITY PROJECT No. 24-9122

BID SET - ADDENDUM #3
ATTACHMENT E - DRAWINGS
MARCH 2026

CITY COMMISSION

Josh Levy, Mayor

Caryl S. Shuham, Commissioner

Peter Hernandez, Commissioner

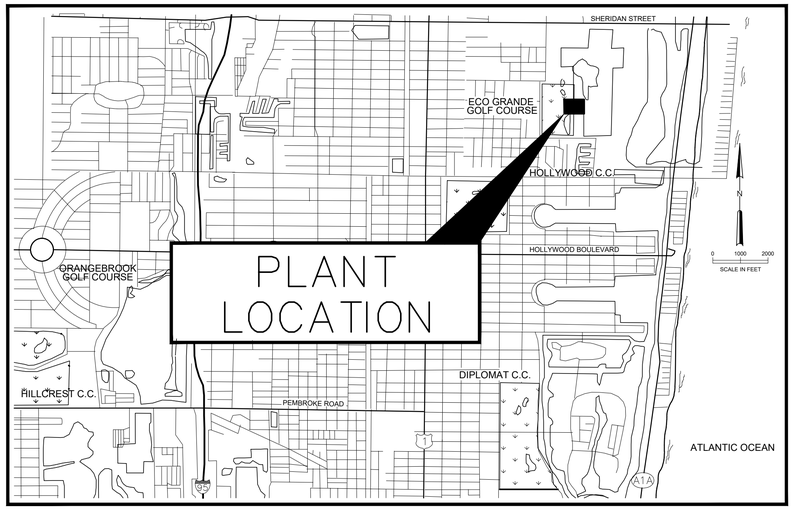
Traci L. Callari, Commissioner

Adam Gruber, Commissioner

Kevin D. Biederman, Commissioner

Idelma Quintana, Commissioner

Vincent Morello, P.E., Director of Public Utilities



SOUTHERN REGIONAL WASTEWATER TREATMENT PLANT
1621 N 14TH AVE,
HOLLYWOOD, FL 33020

LOCATION MAP

NTS

Hazen

HAZEN AND SAWYER
4000 HOLLYWOOD BOULEVARD,
SUITE 750N
HOLLYWOOD, FL 33021

LIST OF DRAWINGS

DWG No.	TITLE
	GENERAL
G-01	TITLE SHEET, LOCATION MAP AND LOCATION MAP
G-02	LIST OF ABBREVIATIONS, SYMBOLS ANDCALLOUTS IDENTIFICATION
G-03	OVERALL SITE, STAGING AND KEY PLAN
	DEMOLITION
D-01	EXISTING SITE AND DEMO PLAN
	CIVIL
C-01	GENERAL NOTES AND LEGEND
C-02	ENLARGED SITE PLAN AREA A
C-03	ENLARGED SITE PLAN AREA B
C-04	ENLARGED SITE PLAN AREA C
C-05	TYPICAL DETAILS SHEET 1
C-06	TYPICAL DETAILS SHEET 2
C-07	TYPICAL DETAILS SHEET 3
C-08	EROSION CONTROL PLAN
C-09	STORMWATER POLLUTION PREVENTION PLAN - SHEET 1
C-10	STORMWATER POLLUTION PREVENTION PLAN - SHEET 2
	MECHANICAL
M-01	TEMPORARY HYPOCHLORITE SYSTEM ENLARGED PLAN
M-02	TEMPORARY HYPOCHLORITE SYSTEM SECTIONS 1
M-03	TEMPORARY HYPOCHLORITE SYSTEM SECTIONS 2
M-04	TEMPORARY HYPOCHLORITE SYSTEM SECTIONS 3
M-05	TEMPORARY HYPOCHLORITE SYSTEM SECTIONS 4
M-06	REUSE FILTERS AND CHLORINE CONTACT TANKS ENLARGED PLAN
M-07	REUSE FILTERS AND CHLORINE CONTACT TANKS SECTION 1
M-08	REUSE FILTERS AND CHLORINE CONTACT TANKS DETAILS
M-09	REUSE FILTERS AND CHLORINE CONTACT TANKS DETAILS
M-10	CHLORINE BUILDING PLAN
M-11	CHLORINE BUILDING SECTION
M-12	CHLORINE BUILDING PHOTOS
M-13	INJECTION POINT 7B INJECTION WELL DIVERSION BOX PIPING DETAILS
M-14	INJECTION POINT 7A HYDRAULIC BOX PIPING DETAILS
M-15	NaOCl INJECTION POINTS STATION FOR HYDRAULIC BOX & INJECTION DIVERSION
M-16	TYPICAL DETAILS 1
M-17	TYPICAL DETAILS 2
M-18	TYPICAL DETAILS 3
M-19	CHEMICAL SIGNAGE DETAILS
	STRUCTURAL
S-01	NOTES
S-02	TEMPORARY HYPOCHLORITE SYSTEM FOUNDATION PLAN
S-03	TEMPORARY HYPOCHLORITE SYSTEM FLOOR PLAN
S-04	TEMPORARY HYPOCHLORITE SYSTEM SECTIONS - I
S-05	TEMPORARY HYPOCHLORITE SYSTEM SECTIONS - II
S-06	TEMPORARY HYPOCHLORITE SYSTEM SECTIONS - III
S-07	TEMPORARY HYPOCHLORITE SYSTEM DETAILS - I
S-08	TEMPORARY HYPOCHLORITE SYSTEM PIPE BRIDGE DETAILS
S-09	TYPICAL DETAILS SHEET 1
S-10	TYPICAL DETAILS SHEET 2
	ARCHITECTURAL
A-01	TEMPORARY HYPOCHLORITE SYSTEM LINE SAFETY PLAN
	INSTRUMENTATION
I-01	SYMBOLS AND LEGEND
I-02	NETWORK BLOCK DIAGRAM
I-03	SODIUM HYPOCHLORITE BULK STORAGE TANKS P&ID
I-04	SODIUM HYPOCHLORITE FEED SYSTEM P&ID - SHEET 1
I-05	SODIUM HYPOCHLORITE FEED SYSTEM P&ID - SHEET 2
I-06	SODIUM HYPOCHLORITE FEED SYSTEM P&ID - SHEET 3
I-07	SODIUM HYPOCHLORITE FEED & TRANSFER SYSTEM P&ID
I-08	MISCELLANEOUS P&ID
I-09	TYPICAL DETAILS - SHEET 1
I-10	TYPICAL DETAILS - SHEET 2
I-11	TYPICAL DETAILS - SHEET 3
	ELECTRICAL
E-01	GENERAL NOTES
E-02	LEGEND AND SYMBOLS
E-03	SITE PLAN - OVERALL
E-04	TEMPORARY HYPOCHLORITE SYSTEM POWER AND LIGHTING PLAN
E-05	POWER AND CONTROL RISER DIAGRAM SHEET 1
E-06	POWER AND CONTROL RISER DIAGRAM SHEET 2
E-07	POWER AND CONTROL RISER DIAGRAM SHEET 3
E-08	SCHEDULES
E-09	TYPICAL DETAILS SHEET 1
E-10	TYPICAL DETAILS SHEET 2
E-11	TYPICAL DETAILS SHEET 3

LEGEND

EXISTING PIPING LINE TYPES	DESCRIPTION
	SOIL BORING
	CONCRETE UTILITY POLE
× 6.94	EXISTING ELEVATION
	CENTER LINE
FOC OHE	OVERHEAD WIRES
	PROPERTY LINE
	RIGHT-OF-WAY LINE
UGE	UNDERGROUND CONDUIT
GAS	UNDERGROUND GAS PIPE
FM FM FM FM	UNDERGROUND FORCE MAIN
FOC	UNDERGROUND FIBER OPTIC LINE
SS	UNDERGROUND SANITARY SEWER PIPE
SD	UNDERGROUND STORM DRAIN PIPE
UNK	UNDERGROUND UNKNOWN LINE
W	UNDERGROUND WATER PIPE
	MATCH LINE

	EXISTING	DEMO	NEW
ASPHALT PAVEMENT			
BUILDING/STRUCTURE			
CONCRETE CURB			
CONCRETE PAD/PAVEMENT			
CONCRETE SIDEWALK			
CONSTRUCTION ENTRANCE			
EARTH/GRADE			
GRAVEL			
WETLANDS			
SILT FENCE	SF		
SUPER SILT FENCE	SSF		SSF
DRAINAGE SWALE			
TREE PROTECTION FENCE	TPF		TPF
LIMITS OF DISTURBANCE	LOD		LOD

ABBREVIATIONS

EM	ELECTRIC MANHOLE
GM	GAS METER
MB	MAIL BOX
CO	CLEAN OUT
SD	STORM DRAIN
IP	IRON PIN
TR	TRAFFIC SIGNAL
UNK	UNKNOWN
FH	FIRE HYDRANT
YH	YARD HYDRANT
WM	WATER METER
FG	FINISHED GRADE
US	UPSTREAM
DS	DOWNSTREAM
HP	HIGH POINT
ABC	AGGREGATE BASE COURSE

SYMBOLS

	EXISTING	NEW		EXISTING	NEW
BOLLARD/ POST			SEWER MANHOLE		⦿
COMMUNICATION BOX			SEWER VALVE		
COMMUNICATION MANHOLE			STORM FLARED END SECTION		
ELECTRICAL BOX			STORM HEADWALL		
ELECTRICAL GUY WIRE			STORM INLET		▣
ELECTRIC LIGHT POLE			STORM MANHOLE		⦿
ELECTRICAL MANHOLE			SURVEY BENCHMARK		
ELECTRIC METER			SURVEY HIGHWAY MONUMENT		
ELECTRICAL POWER POLE			SURVEY IRON PIN		
FIBER OPTIC BOX			TELEPHONE BOX		
GAS METER			TELEPHONE MANHOLE		
GAS VALVE			TRAFFIC SIGNAL BOX		
MAIL BOX			UNKNOWN VALVE		
ROAD SIGNAGE			WATER HYDRANT (FIRE)		
			WATER HYDRANT (YARD)		
ROAD MARKINGS			WATER MANHOLE		
			WATER METER		
SEWER AIR RELEASE VALVE	◎	◎	WATER VALVE		
SEWER CLEANOUT			WETLANDS FLAG		

GENERAL NOTES:

1. LOCATION, SIZE, MATERIAL, ALIGNMENT, AND ELEVATIONS OF EXISTING FACILITIES HAVE BEEN DETERMINED FROM AVAILABLE RECORDS. THIS INFORMATION IS FURNISHED AS A GUIDE FOR THE CONTRACTOR. THE ENGINEER AND THE OWNER DO NOT GUARANTEE THE ACCURACY OF THESE DATA. THE CONTRACTOR SHALL BE FULLY RESPONSIBLE FOR DETERMINING THE LOCATION AND PROTECTING ALL TYPES OF UTILITIES AND STRUCTURES ENCOUNTERED DURING THE COURSE OF THIS PROJECT.
2. OBTAIN WRITTEN APPROVAL FROM THE ENGINEER FOR ANY DEVIATIONS FROM THE PLANS AND/OR SPECIFICATIONS.
3. FIELD VERIFY ALL DIMENSIONS AND ELEVATIONS PRIOR TO COMMENCEMENT OF CONSTRUCTION AND NOTIFY THE ENGINEER IMMEDIATELY OF ANY REQUIRED PLAN DEVIATIONS.
4. RESTRAINED JOINT PIPE SHALL BE USED FOR ALL PIPING ON THIS PROJECT. PIPE JOINT RESTRAINT USING THRUST BLOCKS SHALL NOT BE PERMITTED.
5. RECORD ELEVATIONS OF EXISTING BURIED UTILITIES AT ALL ENCOUNTERED CROSSINGS WITH NEW WORK.
6. ALL CONNECTIONS TO EXISTING PIPING SHALL BE MADE UNDER THE DIRECTION OF THE OWNER. REFER TO SECTION 01 14 00 FOR CONSTRUCTION SEQUENCING AND CONSTRAINTS REQUIREMENTS AND MANDATORY SHUTDOWN REQUEST FORM.
7. MINIMUM DEPTH OF COVER FOR ALL UNDERGROUND PIPING SHALL BE 36" EXCEPT WHERE SHOWN OTHERWISE ON PLANS.
8. BE RESPONSIBLE AT ALL TIMES THROUGHOUT THE DURATION OF CONSTRUCTION AND UNTIL ACCEPTANCE OF THE WORK FOR THE PROTECTION OF EXISTING AND NEWLY INSTALLED UTILITIES FROM DAMAGE OR DISRUPTION OF SERVICE.
9. ADJUST TO FINAL GRADE ALL EXISTING UTILITY CASTINGS INCLUDING VALVE BOXES, MANHOLES, HAND HOLES, PULL BOXES, INLETS AND SIMILAR STRUCTURES IN CONSTRUCTION AREA TO BE OVERLAID WITH ASPHALT.
10. CONTRACTOR SHALL MAINTAIN ACCESS TO PRIVATE PROPERTY AT ALL TIMES.
11. WHERE PROPOSED WORK IS IN VICINITY OF UTILITY POLES SUCH THAT SUPPORT OF POLES WILL BE REQUIRED, NOTIFY UTILITY OF WORK AND COORDINATE WITH UTILITY FOR SUPPORT OF POLE.
12. DISPOSE OF UNSUITABLE MATERIAL IN A PROPER MANNER.
13. TAKE ALL PRECAUTIONARY MEASURES NECESSARY TO PROTECT EXISTING EQUIPMENT REMAINING IN PLACE FROM DAMAGE. ANY IMPROVEMENTS DAMAGED BY THE CONTRACTOR'S OPERATIONS SHALL BE EXPEDITIOUSLY REPAIRED OR RECONSTRUCTED TO THE ENGINEER'S SATISFACTION AT THE CONTRACTOR'S EXPENSE WITHOUT ADDITIONAL COMPENSATION.
14. ALL MATERIALS AND EQUIPMENT TO BE DEMOLISHED SHALL BE DISPOSED OF IN ACCORDANCE WITH LOCAL AND STATE REGULATIONS.
15. REFER TO SPECIFICATIONS FOR REQUIREMENTS OF MAINTENANCE OF TRAFFIC.
16. ALL EXISTING UNDERGROUND UTILITIES SHALL BE PROTECTED. IF DAMAGED, UTILITIES SHALL BE RESTORED TO ORIGINAL CONDITIONS OR BETTER.
17. PRIOR TO EXCAVATION, CONTACT UNDERGROUND SERVICE ALERT (USA) AT 811 OR (800) 642-2444. COORDINATE WITH UTILITY COMPANIES AFFECTED BY CONSTRUCTION.

ALL BURIED DUCTILE IRON PIPE SHALL BE POLYETHYLENE ENCASED.

EROSION AND SEDIMENTATION CONTROL

1. THE CONTRACTOR IS RESPONSIBLE FOR THE PERMITTING, DESIGN, AND MAINTENANCE OF EROSION AND SEDIMENTATION CONTROL MEASURES.
2. COMPLY WITH THE REQUIREMENTS IN THE SPECIFICATION SECTION 31 25 00. TITLED "EROSION AND SEDIMENTATION CONTROL.

PROPERTY INFORMATION NOTES

PROPERTY ADDRESS:
CITY OF HOLLYWOOD
SOUTHERN REGIONAL WASTEWATER TREATMENT PLANT
1621 N 14th AVE, HOLLYWOOD, FL 33020

PROPERTY INFORMATION:
FOLIO: 5142 10 27 0020
ZONING: 89-04

PROPERTY OWNER INFORMATION:
OWNER: CITY OF HOLLYWOOD

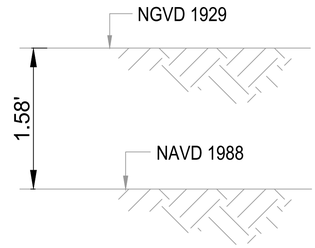
PROPERTY LOCATION:
COUNTY: BROWARD
TOWNSHIP: 51
SECTION: 11

UNLESS SHOWN OTHERWISE, THE ELEVATIONS SHOWN HEREON ARE RELATIVE TO NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88) AND ARE BASED ON THE FOLLOWING BENCHMARK OF ORIGIN:
· BM6. FOUND FDOT PNC MONUMENT, ALUMINUM DISC SET IN CONCRETE STAMPED "86/16/C06", APPROXIMATELY 22 FEET RIGHT OF STATION 149+33.24 ALONG THE BASELINE ESTABLISHED IN FDOT FINANCIAL PROJECT ID 434690-1-52-01 . DISC SET IN FACE OF CONCRETE SIDEWALK AT THE NORTHWEST CORNER OF THE INTERSECTION OF TAFT STREET AND N. 14th AVENUE. ELEVATION = 3.054FT

VERTICAL DATUM CONVERSION

THE FOLLOWING GRAPHIC ILLUSTRATES CONVERTING NGVD 1929 TO NAVD 1988.

MECHANICAL SHEETS M-06 THRU M-14 SHOW ELEVATIONS REFERRING TO NGVD 1929



REV	ISSUED FOR	DATE	BY
1	ADDENDUM NO. 3	03/2026	

PROJECT ENGINEER: J. BOWDAN
DESIGNED BY: A. QIU
DRAWN BY: J. COPPOLA
CHECKED BY: P. COOKE
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE 0 1/2" 1"

Hazen
HAZEN AND SAWYER
4000 HOLLYWOOD BLVD SUITE 750N
HOLLYWOOD, FL 33021

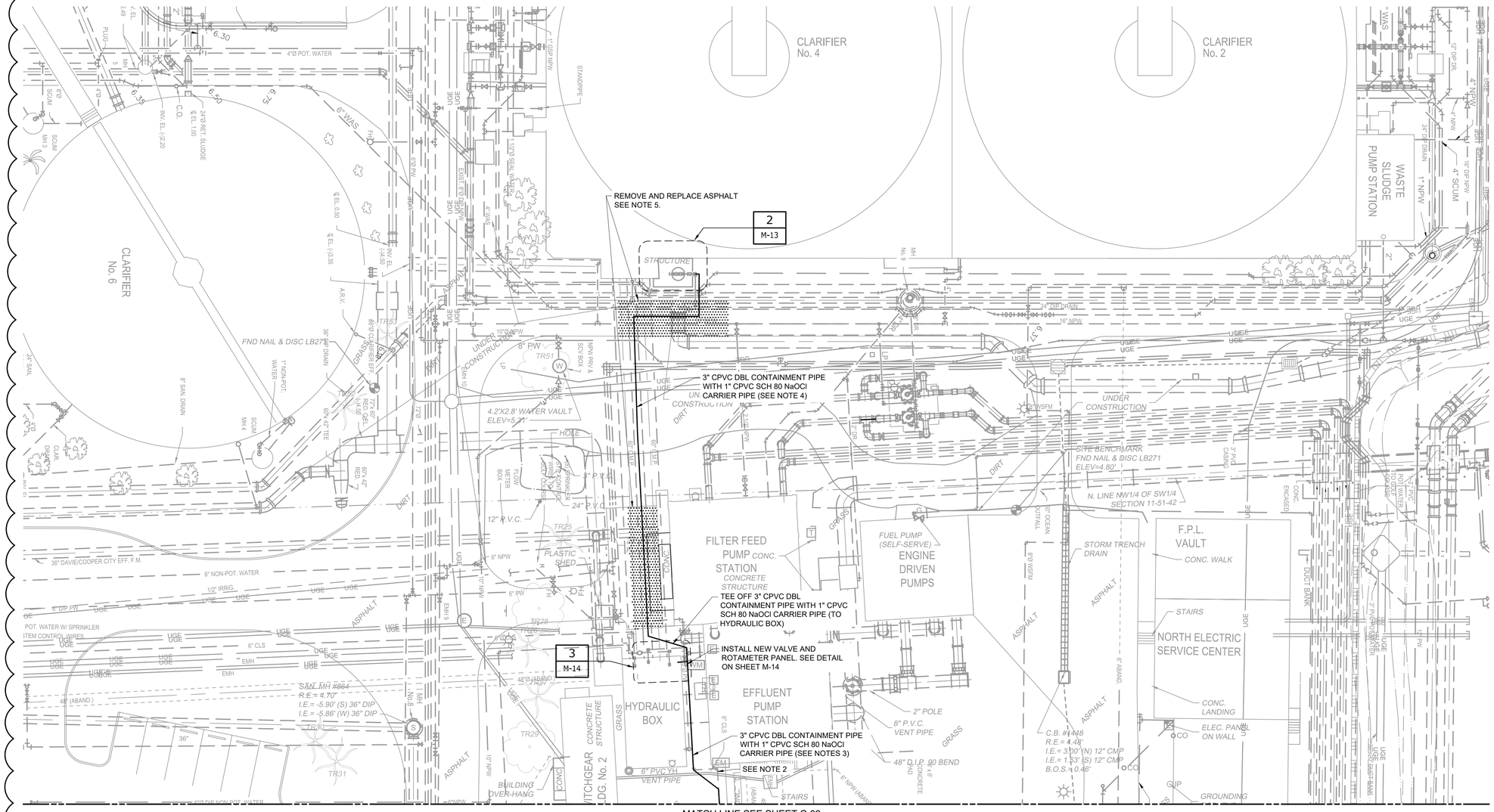
CITY OF HOLLYWOOD
HOLLYWOOD, FLORIDA

SODIUM HYPOCHLORITE
TEMPORARY STORAGE AND FEED SYSTEM

CIVIL
GENERAL NOTES AND LEGEND

DATE: MARCH 2026
HAZEN NO.: 4321-111
CONTRACT NO.: 22-8073
DRAWING NUMBER: C-01

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PLOT DATE: 3/13/2026 7:22 PM BY: JCOPPOLA



PLAN
SCALE: 1" = 20'

NOTES:

1. EXISTING UNDERGROUND UTILITIES SHOWN ON THIS SHEET ARE APPROXIMATELY LOCATED. CONTRACTOR SHALL POTHOLE EXISTING UTILITIES AS NECESSARY TO AVOID CONFLICT WITH NEW BURIED PIPING. CONTRACTOR SHALL BE RESPONSIBLE TO MAKE ALIGNMENT ADJUSTMENT WITH NEW BURIED PIPING AS NECESSARY TO AVOID CONFLICT WITH EXISTING UTILITIES.
2. PROTECT AND MAINTAIN EXISTING 6" CLS IN SERVICE UNTIL NEW TEMPORARY SODIUM HYPOCHLORITE FACILITY HAS BEEN PLACED INTO SERVICE SEE SECTION 01 14 00 FOR PROJECT SEQUENCING AND COORDINATION REQUIREMENTS.
3. INSTALL NEW 3" PVC DBL CONTAINMENT PIPE WITH 1" CPVC SCH 80 NaOCl CARRIER PIPE TO HYDRAULIC BOX BELOW GROUND (SEE DETAIL IN M-14).
4. EXTEND NEW 3" PVC DBL CONTAINMENT PIPE WITH 1" CPVC SCH 80 NaOCl CARRIER PIPE TO INJECTION WELL DIVERSION STRUCTURE (SEE DETAIL IN M-13).
5. REPLACE ASPHALT AS NEEDED TO INSTALL CIVIL PIPING. ENSURE TRENCH AND ADJACENT STRUCTURES STABILITY AND INTEGRITY. RESURFACE A MINIMUM OF 12.5' BEYOND ANY OPEN CUT LIMITS IN ALL DIRECTIONS. REFER TO DETAIL G12.1 ON SHEET C-06.

REV	ISSUED FOR	DATE	BY
1	ADDENDUM NO. 3	03/2026	

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE (0 1/2" 1")

PROJECT ENGINEER:	J. BOWDAN
DESIGNED BY:	A. QIU
DRAWN BY:	J. COPPOLA
CHECKED BY:	P. COOKE

Hazen
HAZEN AND SAWYER
4000 HOLLYWOOD BLVD SUITE 750N
HOLLYWOOD, FL 33021

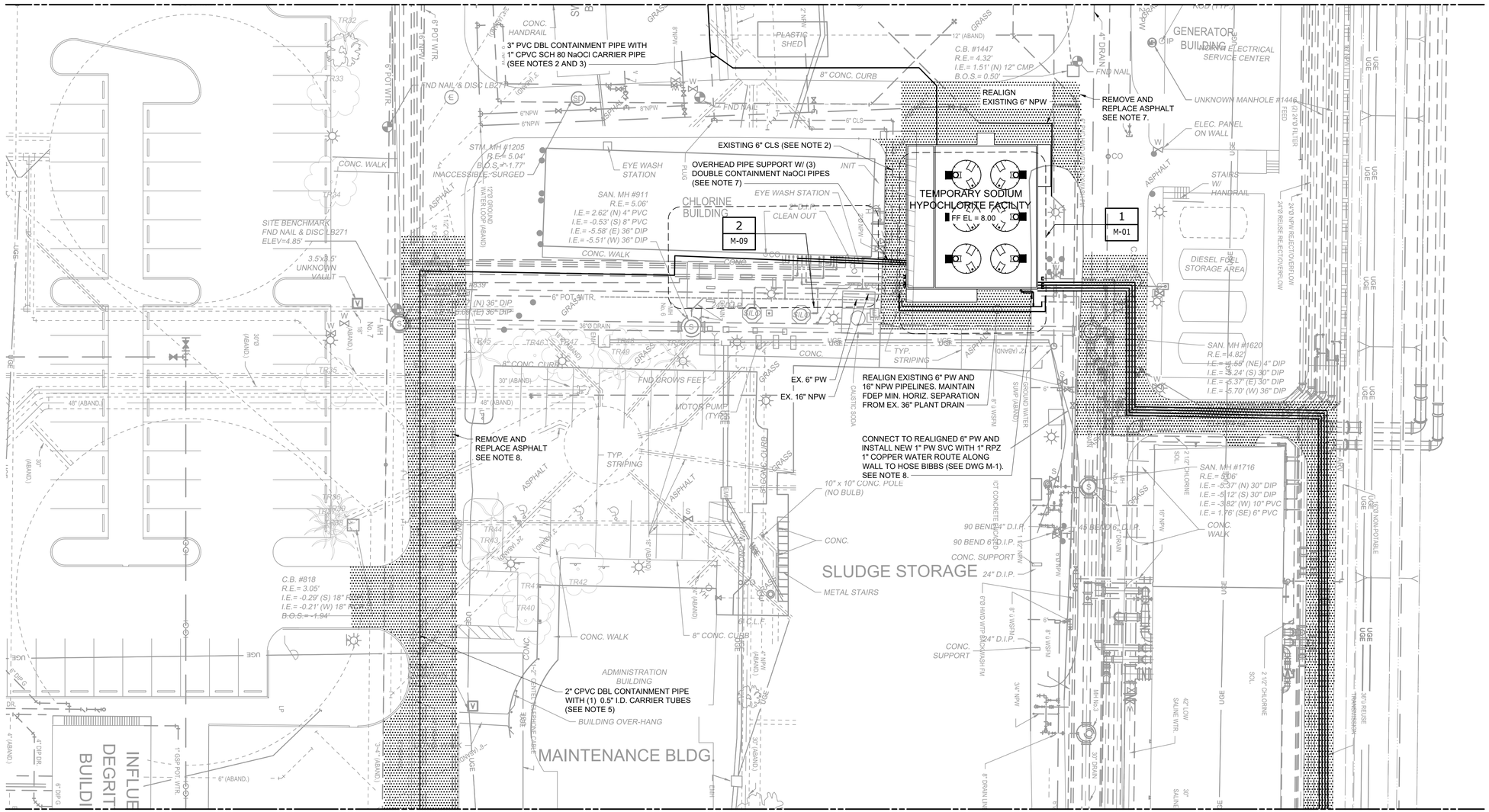
CITY OF HOLLYWOOD
HOLLYWOOD, FLORIDA

SODIUM HYPOCHLORITE
TEMPORARY STORAGE AND FEED SYSTEM

CIVIL
ENLARGED SITE PLAN
AREA A

DATE:	MARCH 2026
HAZEN NO.:	4321-111
CONTRACT NO.:	22-8073
DRAWING NUMBER:	C-02

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PLOT DATE: 3/13/2026 6:45 PM BY: JCOPPOLA



PLAN
SCALE: 1" = 20'

NOTES:

1. EXISTING UNDERGROUND UTILITIES SHOWN ON THIS SHEET ARE APPROXIMATELY LOCATED. CONTRACTOR SHALL POTHOLE EXISTING UTILITIES AS NECESSARY TO AVOID CONFLICT WITH NEW BURIED PIPING. CONTRACTOR SHALL BE RESPONSIBLE TO MAKE ALIGNMENT ADJUSTMENT WITH NEW BURIED PIPING AS NECESSARY TO AVOID CONFLICT WITH EXISTING UTILITIES.
2. PROTECT AND MAINTAIN EXISTING 6" CLS IN SERVICE UNTIL NEW TEMPORARY SODIUM HYPOCHLORITE FACILITY HAS BEEN PLACED INTO SERVICE SEE SECTION 01 14 00 FOR PROJECT SEQUENCING AND COORDINATION REQUIREMENTS.
3. INSTALL NEW 3" CPVC DBL CONTAINMENT PIPE WITH 1" CPVC SCH 80 NaOCl CARRIER PIPE TO HYDRAULIC BOX BELOW GROUND (SEE DETAIL IN M-14).
4. INSTALL FOUR (4) NEW INDIVIDUAL 2" CPVC SCH 80 CONTAINMENT PIPE WITH 0.25" I.D. CARRIER TUBING FROM THE METERING PUMPS TO THE FOLLOWING LOCATIONS:
   - 4.1. REUSE INFLUENT BOX
   - 4.2. REUSE CCT
   - 4.3. NON-POTABLE INFLUENT BOX
   - 4.4. NON-POTABLE CCT
5. INSTALL NEW 2" CPVC SCH 40 CONTAINMENT PIPE WITH (1) 0.5" I.D. CARRIER TUBING (PER PLAN) FROM HEADWORKS ODOR CONTROL METERING PUMPS AT THE NEW TEMP SODIUM HYPOCHLORITE FACILITY (THIS SHEET) TO THE HEADWORKS ODOR CONTROL DOSING POINT (DWG C-04).
6. SEE OVERHEAD PIPE SUPPORT DETAILS, ON DWG S-12. SUPPORTED PIPE TO INCLUDE THE FOLLOWING:
   - A) 2" CPVC SCH 40 CONTAINMENT PIPE WITH (1) 0.5" I.D. CARRIER TUBING TO HEADWORKS ODOR CONTROL
   - B) 2" CPVC SCH 40 CONTAINMENT PIPE WITH 0.5" I.D. TUBING TO DOSING POINT AT EXIST. 3" CLS TO INFLUENT PUMP STATION.
   - C) 2" CPVC SCH 40 CONTAINMENT PIPE WITH 0.5" I.D. TUBING TO VALVE PANEL AND DOSING POINTS AT EXIST. 3" CLS PIPES TO RAS 1, 2, 3, 4, AND 5 LOCATIONS.
7. REPLACE ASPHALT AS NEEDED TO INSTALL CIVIL PIPING. ENSURE TRENCH AND ADJACENT STRUCTURES STABILITY AND INTEGRITY. RESURFACE A MINIMUM OF 12.5' BEYOND ANY OPEN CUT LIMITS IN ALL DIRECTIONS. REFER TO DETAIL G12.1 ON SHEET C-06.
8. PLUMBING WORK TO BE PERFORMED ON C-03 AND M-01 SHALL INCLUDE THE FOLLOWING: NEW 1-INCH WATER SERVICE TAP TO RELOCATED 6-INCH POTABLE WATER MAIN, 6 LF OF BURIED 1-INCH COPPER SERVICE LINE TO RPZ, 1-INCH RPZ ASSEMBLY, 105-LF OF ABOVE GROUND 1-INCH COPPER WATER SERVICE LINE TO HOSE BIBBS AND FOUR (4) EYEWASH SHOWERS.

REV	ISSUED FOR	DATE	BY
1	ADDENDUM NO. 3	03/2026	

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE (0, 1/2", 1")

PROJECT ENGINEER:	J. BOWDAN
DESIGNED BY:	A. QIU
DRAWN BY:	J. COPPOLA
CHECKED BY:	P. COOKE

Hazen
HAZEN AND SAWYER
4000 HOLLYWOOD BLVD SUITE 750N
HOLLYWOOD, FL 33021

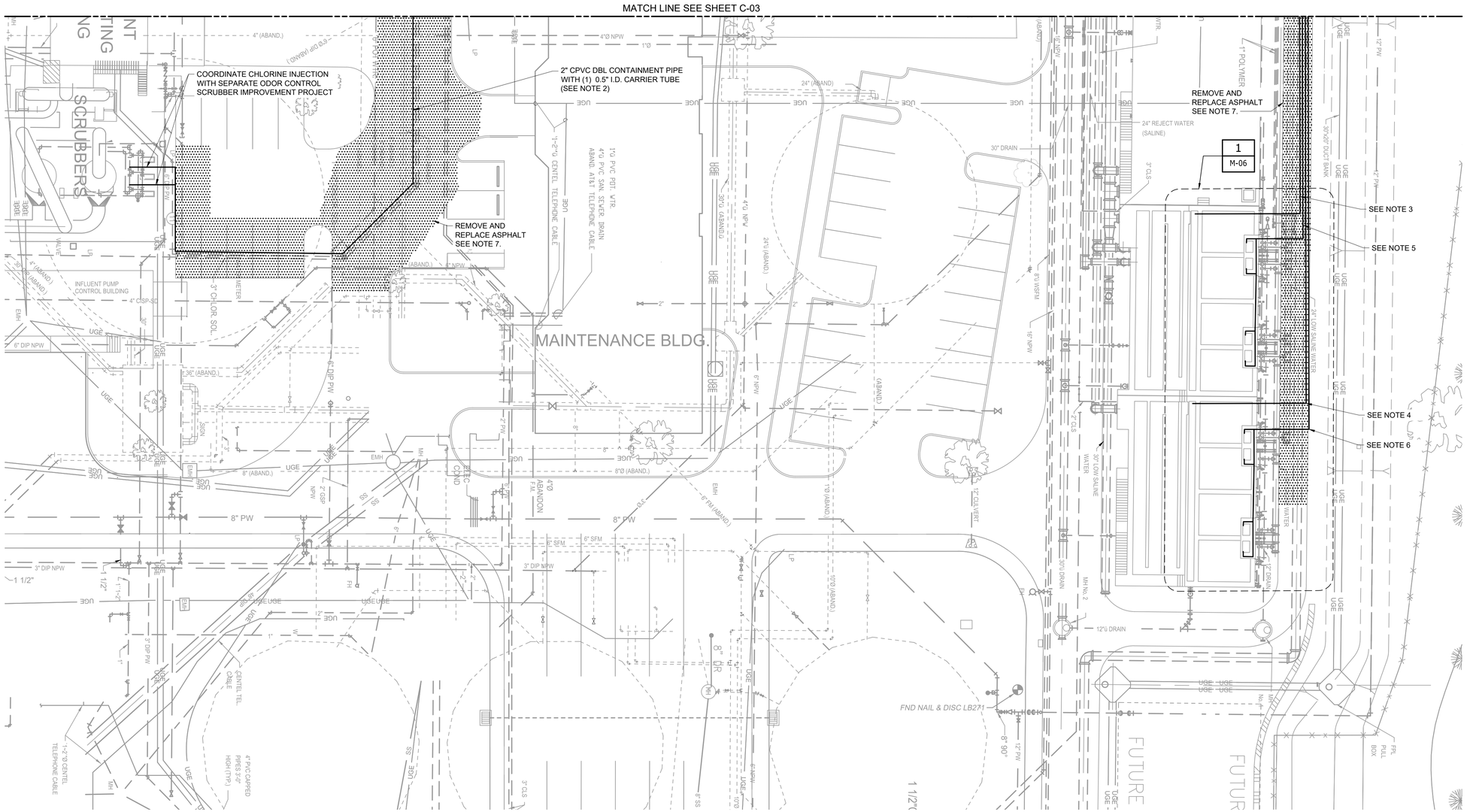
CITY OF HOLLYWOOD
HOLLYWOOD, FLORIDA

SODIUM HYPOCHLORITE
TEMPORARY STORAGE AND FEED SYSTEM

CIVIL
ENLARGED SITE PLAN
AREA B

DATE:	MARCH 2026
HAZEN NO.:	4321-111
CONTRACT NO.:	22-8073
DRAWING NUMBER:	C-03

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PLOT DATE: 3/13/2026 6:45 PM BY: JCOPPOLA



NOTES:

1. EXISTING UNDERGROUND UTILITIES SHOWN ON THIS SHEET ARE APPROXIMATELY LOCATED. CONTRACTOR SHALL POTHOLE EXISTING UTILITIES AS NECESSARY TO AVOID CONFLICT WITH NEW BURIED PIPING. CONTRACTOR SHALL BE RESPONSIBLE TO MAKE ALIGNMENT ADJUSTMENT WITH NEW BURIED PIPING AS NECESSARY TO AVOID CONFLICT WITH EXISTING UTILITIES.
2. INSTALL NEW 2" PVC SCH 40 CONTAINMENT PIPE WITH (1) 0.5" I.D. CARRIER TUBING (PER PLAN) FROM HEADWORKS ODOR CONTROL METERING PUMPS AT THE NEW TEMP SODIUM HYPOCHLORITE FACILITY (DWG C-03) TO THE HEADWORKS ODOR CONTROL CONNECTION (THIS SHEET).
3. INSTALL NEW 2" CPVC SCH 80 CONTAINMENT PIPE WITH 0.25" I.D. CARRIER TUBING FROM REUSE SYSTEM METERING PUMPS (MP-56016/56616) TO THE REUSE CCT.
4. INSTALL NEW 2" CPVC SCH 80 CONTAINMENT PIPE WITH 0.25" I.D. CARRIER TUBING FROM NON-POTABLE SYSTEM METERING PUMPS (MP-56012/56612) TO THE NON-POTABLE CCT.
5. INSTALL NEW 2" CPVC SCH 80 CONTAINMENT PIPE WITH 0.25" I.D. CARRIER TUBING FROM REUSE PRE-CHLORINATION SYSTEM METERING PUMPS (MP-56013A/56613A) TO THE REUSE INFLUENT BOX.
6. INSTALL NEW 2" CPVC SCH 80 CONTAINMENT PIPE WITH 0.25" I.D. CARRIER TUBING FROM REUSE PRE-CHLORINATION SYSTEM METERING PUMPS (MP-56013B/56613B) TO THE NON-POTABLE INFLUENT BOX.
7. REPLACE ASPHALT AS NEEDED TO INSTALL CIVIL PIPING. ENSURE TRENCH AND ADJACENT STRUCTURES STABILITY AND INTEGRITY. RESURFACE A MINIMUM OF 12.5' BEYOND ANY OPEN CUT LIMITS IN ALL DIRECTIONS. REFER TO DETAIL G12.1 ON SHEET C-06.

REV	ISSUED FOR	DATE	BY
1	ADDENDUM NO. 3	03/2026	

PROJECT ENGINEER:	J. BOWDAN
DESIGNED BY:	A. QIU
DRAWN BY:	J. COPPOLA
CHECKED BY:	P. COOKE

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Hazen
HAZEN AND SAWYER
4000 HOLLYWOOD BLVD SUITE 750N
HOLLYWOOD, FL 33021

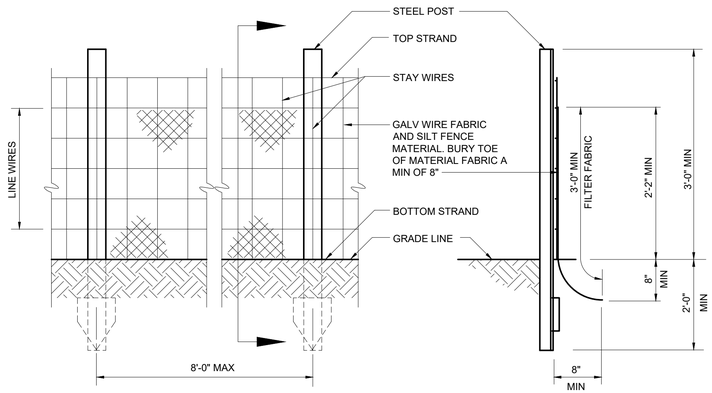
CITY OF HOLLYWOOD
HOLLYWOOD, FLORIDA

SODIUM HYPOCHLORITE
TEMPORARY STORAGE AND FEED SYSTEM

CIVIL
ENLARGED SITE PLAN
AREA C

DATE:	MARCH 2026
HAZEN NO.:	4321-111
CONTRACT NO.:	22-8073
DRAWING NUMBER:	C-04

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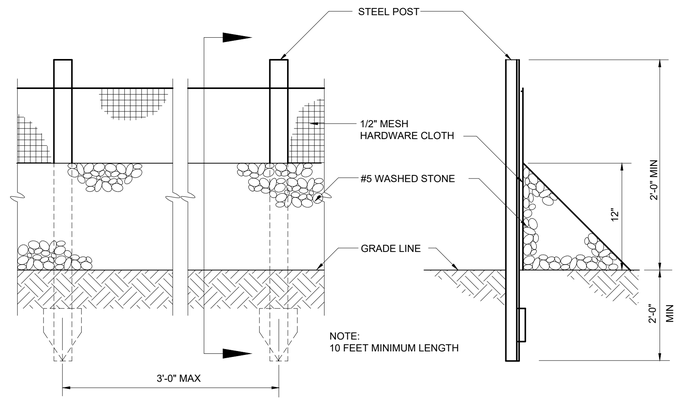
ELEVATION
SILT FENCE

SECTION
SILT FENCE

NOTE:

1. EXTRA STRENGTH SILT FENCE MATERIAL (AS APPROVED BY ENGINEER) WITH 6'-0" POST SPACING DOES NOT REQUIRE MESH SUPPORT FENCE.
2. SILT FENCE MATERIAL SHALL BE WIRED DIRECTLY TO POST.

C-31-0400

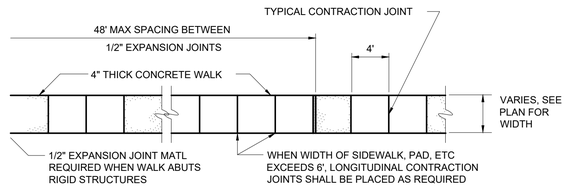


ELEVATION
STONE FILTER

SECTION
STONE FILTER

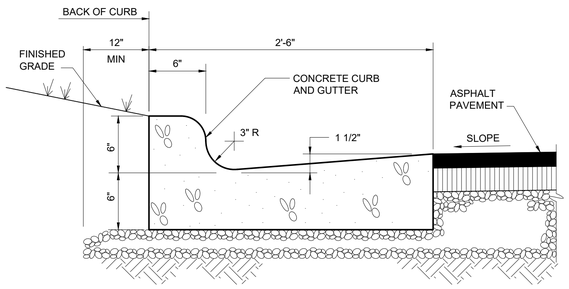
STABILIZED OUTLET FOR SILT FENCE

C-31-0433



TYPICAL CONCRETE WALKWAY

C-32-0520

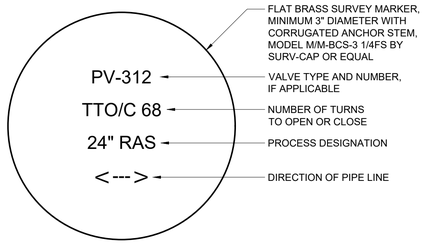


NOTES:

1. CONTRACTION JOINTS SHALL BE PLACED AT 10 FOOT INTERVALS, OR 15 FOOT INTERVALS WHEN A MACHINE IS USED TO PLACE THE CURB.
2. EXPANSION JOINTS SHALL BE PLACED AT 90 FOOT INTERVALS AND ADJACENT TO ALL RIGID OBJECTS.

CURB AND GUTTER

C-32-0530



NOTES:

1. ENGRAVING SHALL BE MINIMUM 3/16" TALL CAPITAL LETTERS IN A BLOCK FONT SIMILAR TO ARIAL, CENTERED AND SPACED AS SHOWN.
2. ALL MARKINGS SHALL BE NEATLY MACHINE ENGRAVED.
3. ALTERNATELY, MARKINGS MAY BE HAND STAMPED, PROVIDED STAMPING IS DEEP ENOUGH TO WITHSTAND NORMAL TRAFFIC AND WEATHERING. STAMPING OF DISK SHALL BE ACCOMPLISHED PRIOR TO SETTING IN CONCRETE VALVE BOX PAD.
4. SUBMIT ONE SAMPLE FOR APPROVAL PRIOR TO ENGRAVING ALL MARKERS.
5. REGARDLESS OF ENGRAVING METHOD SELECTED, CONTRACTOR SHALL PROVIDE COMPATIBLE STAMP SET AND ANVIL TO OWNER UPON COMPLETION OF PROJECT FOR FUTURE REPAIR OF ENGRAVINGS.

C-33-0632

REV	ISSUED FOR	DATE	BY
1	ADDENDUM NO. 3	03/2026	

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PROJECT ENGINEER:	J. BOWDAN
DESIGNED BY:	A. QIU
DRAWN BY:	J. COPPOLA
CHECKED BY:	P. COOKE

Hazen
HAZEN AND SAWYER
4000 HOLLYWOOD BLVD SUITE 750N
HOLLYWOOD, FL 33021

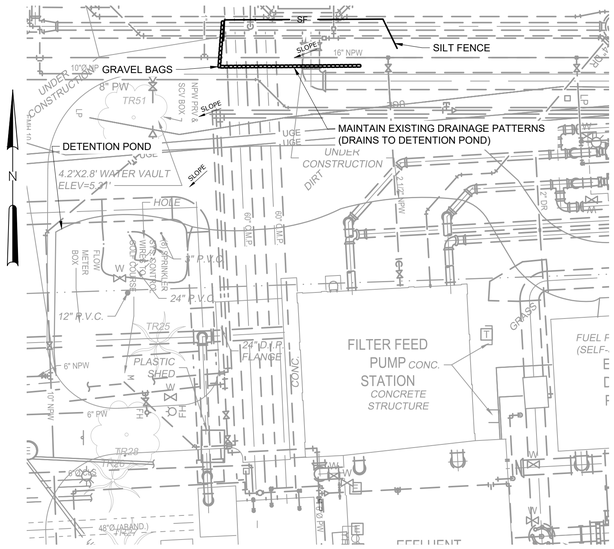
CITY OF HOLLYWOOD
HOLLYWOOD, FLORIDA

SODIUM HYPOCHLORITE
TEMPORARY STORAGE AND FEED SYSTEM

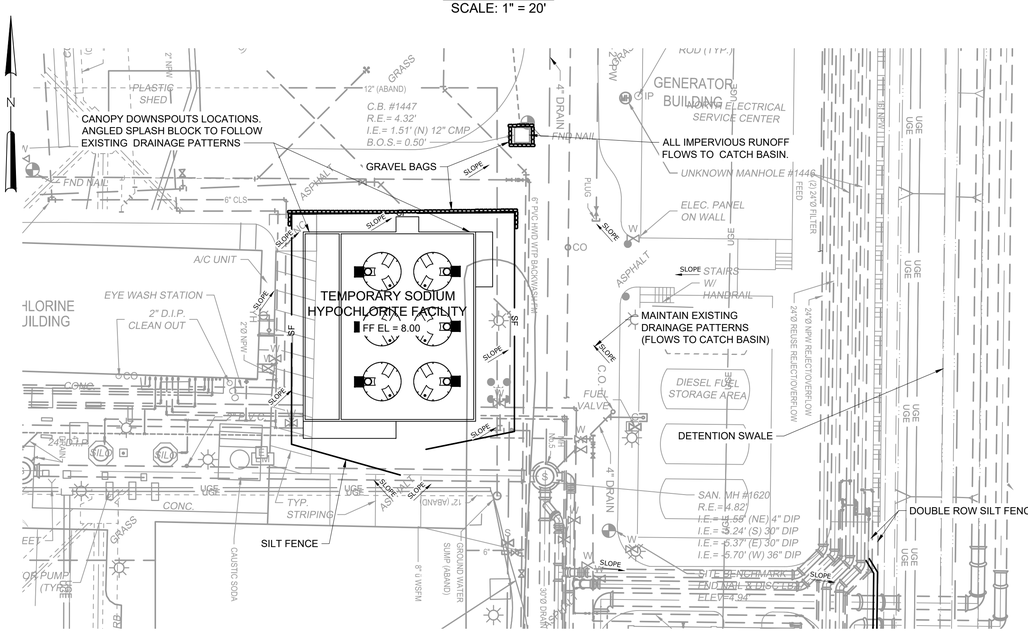
CIVIL
TYPICAL DETAILS 3

DATE:	MARCH 2026
HAZEN NO.:	4321-111
CONTRACT NO.:	22-8073
DRAWING NUMBER:	C-07

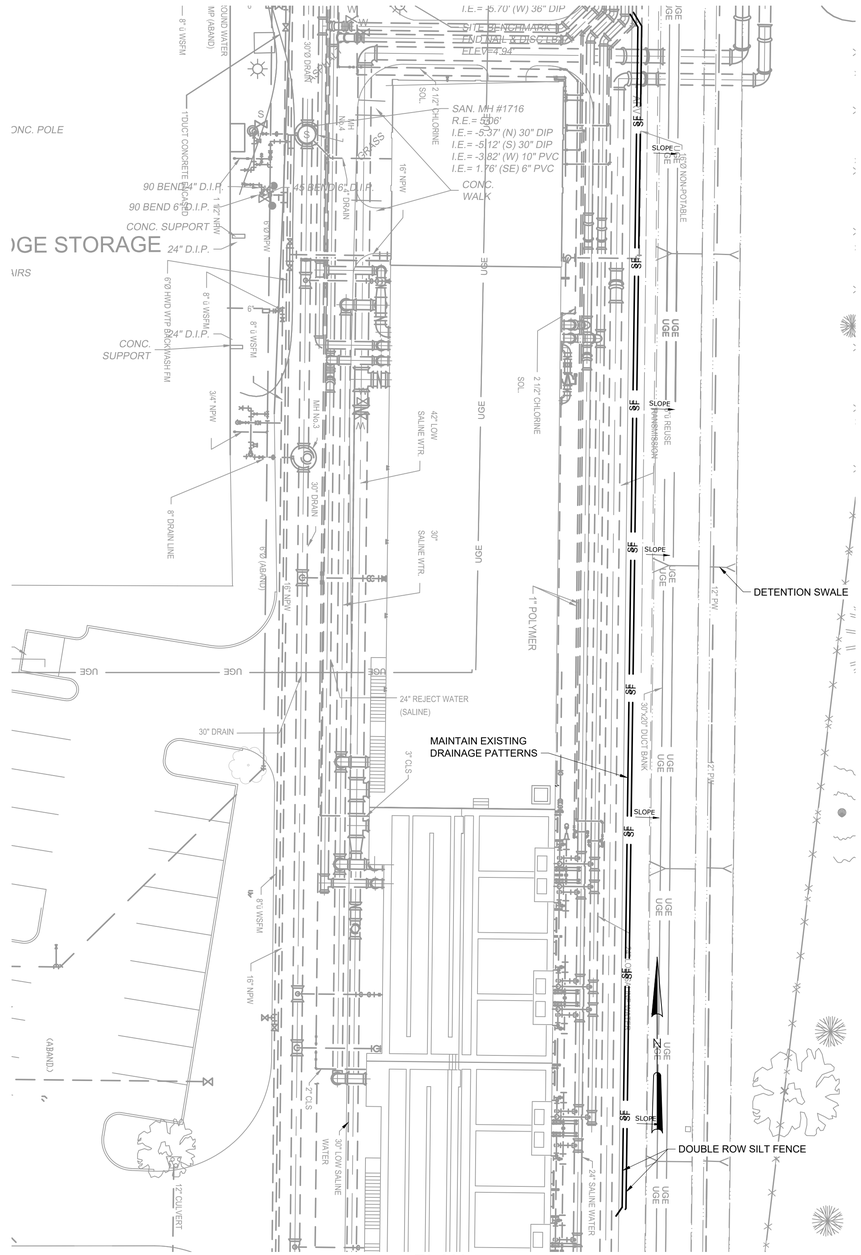
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PLOT DATE: 3/13/2026 6:46 PM BY: JCOPPOLA



PLAN
SCALE: 1" = 20'



PLAN
SCALE: 1" = 20'



PLAN
SCALE: 1" = 20'

NOTES:

1. TEMPORARY SODIUM HYPOCHLORITE FACILITY IS CONSTRUCTED ON EXISTING IMPERVIOUS AREA (PAVED PARKING). ALL WATER COLLECTED ON THE CONCRETE SURFACE OF THE TEMPORARY SODIUM HYPOCHLORITE FACILITY IS PUMPED OUT TO THE SOUTHERN REGIONAL WASTEWATER TREATMENT PLANT

REV	ISSUED FOR	DATE	BY
1	ADDENDUM NO. 3	03/2026	

PROJECT ENGINEER:	J. BOWDAN
DESIGNED BY:	A. QIU
DRAWN BY:	J. COPPOLA
CHECKED BY:	P. COOKE

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE (0, 1/2", 1")

Hazen
HAZEN AND SAWYER
4000 HOLLYWOOD BLVD SUITE 750N
HOLLYWOOD, FL 33021

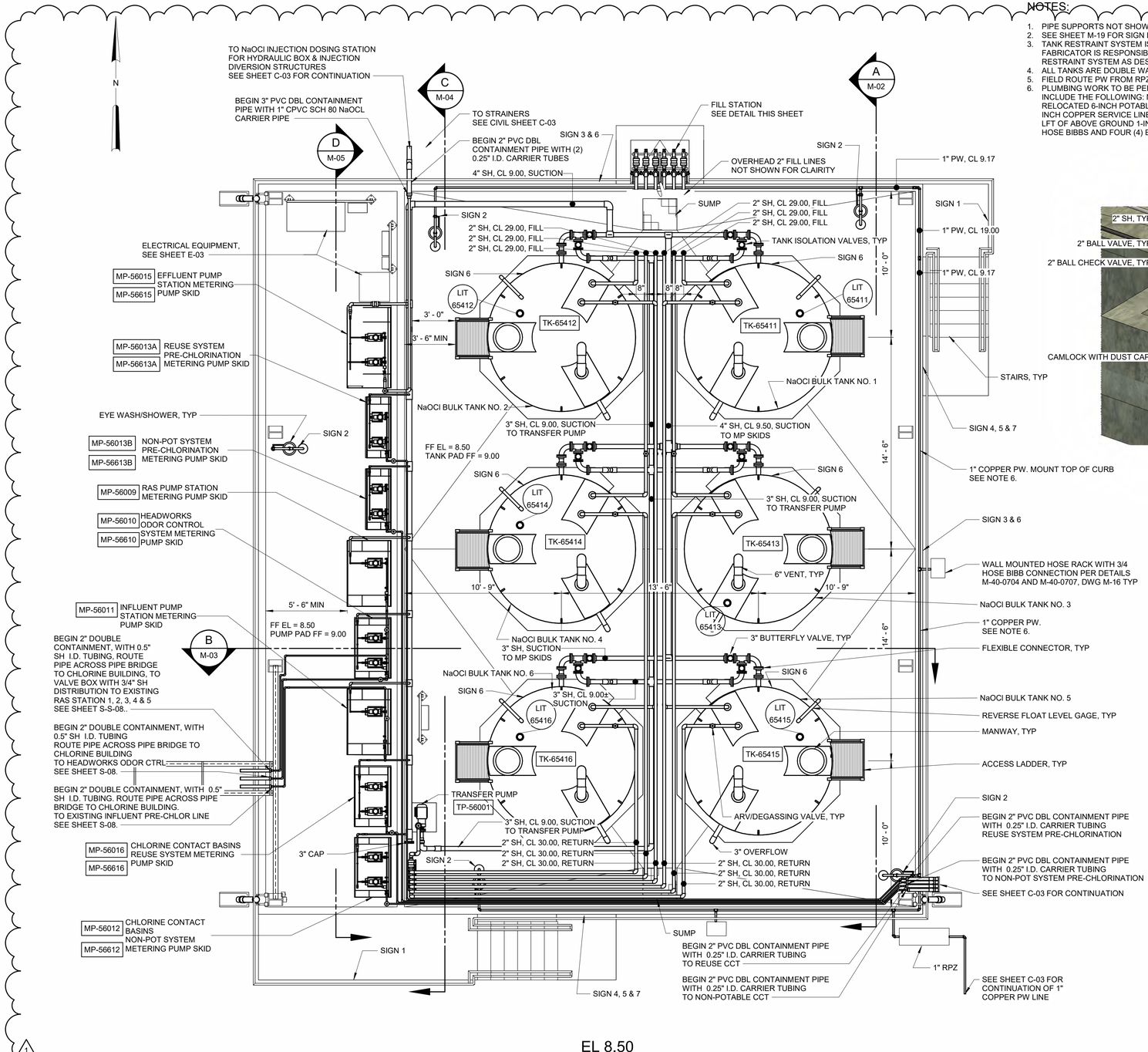
CITY OF HOLLYWOOD
HOLLYWOOD, FLORIDA

SODIUM HYPOCHLORITE
TEMPORARY STORAGE AND FEED SYSTEM

CIVIL
EROSION CONTROL PLAN

DATE:	MARCH 2026
HAZEN NO.:	4321-111
CONTRACT NO.:	22-8073
DRAWING NUMBER:	C-08

File: C:_DC\ACCDOCS\HAZEN AND SAWYER\04321-111\PROJECT FILES\1-DESIGN\01-HAZEN\CIVIL\04321-111-C-08 Saved by JCOPPOLA Save date: 3/7/2026 12:31 PM
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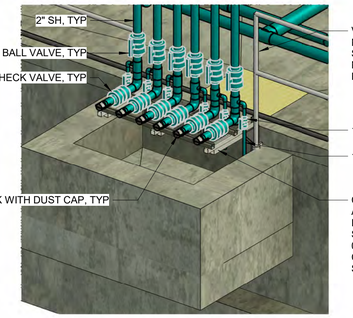


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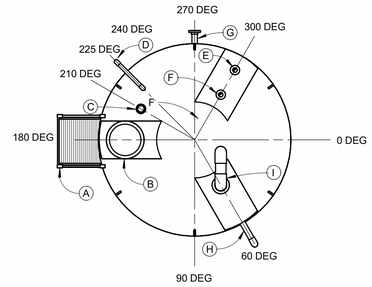
1/4" = 1'-0"

NOTES:

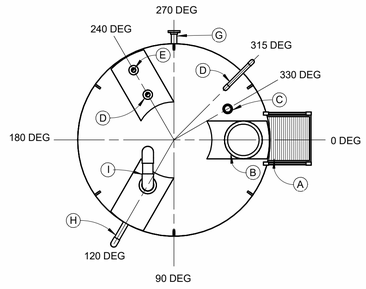
1. PIPE SUPPORTS NOT SHOWN FOR CLARITY, SEE M-18.
2. SEE SHEET M-19 FOR SIGN DETAILS
3. TANK RESTRAINT SYSTEM IS NOT SHOWN FOR CLARITY. THE TANK FABRICATOR IS RESPONSIBLE FOR THE DESIGN OF TANK RESTRAINT SYSTEM AS DESCRIBED IN SPECIFICATION 43 41 43.
4. ALL TANKS ARE DOUBLE WALLED CONTAINMENT TYPE.
5. FIELD ROUTE PW FROM RPZ TO EYEWASH/SHOWER STATIONS.
6. PLUMBING WORK TO BE PERFORMED ON C-03 AND M-01 SHALL INCLUDE THE FOLLOWING: NEW 1-INCH WATER SERVICE TAP TO RELOCATED 6-INCH POTABLE WATER MAIN, 6 LFT OF BURIED 1-INCH COPPER SERVICE LINE TO RPZ, 1-INCH RPZ ASSEMBLY, 105-LFT OF ABOVE GROUND 1-INCH COPPER WATER SERVICE LINE TO HOSE BIBBS AND FOUR (4) EYEWASH SHOWERS.



FILL STATION



TANKS TK-65412, 65414, 65416



TANKS TK-65411, TK-65413, TK-65415

NOZZLE SCHEDULE & ACCESSORIES

MK	SERVICE	FITTING	TK-65412 TK-65412 TK-65416 DEG	TK-65412 TK-65412 TK-65416 DEG	NOZZLE ATTACHMENT ELEVATION
A	LADDER	FRP LADDER WITH PLATFORM AND 3'-6" WALKTHROUGH. PROVIDE ATTACHMENT BRACKETS AND STANDOFFS.	0	180	SIDEWALL
B	ACCESS/VENT	24" BOLTED ACCESS LID WITH INTEGRAL 8" SCREENED VENT	0	180	TOP FLAT
C	LEVEL SENSOR	6" FLANGED NOZZLE FITTING	330	210	TOP DOME
D	REVERSE LEVEL GAGE	REVERSE FLOAT SITE GAUGE WITH PVC STILLING WELL, TANK FITTING, PVC ELBOWS WITH ROLLER PULLEYS, CLEAR PVC SITE TUBE, FLOAT, INDICATOR AND PP ROPE (COMPLETE)	315	225	TOP DOME
E	TANK FILL	2" NOZZLE FITTING FOR TANK FILL	240	300	TOP FLAT
F	TRANSFER	2" NOZZLE FITTING FOR TRANSFER RETURN	330	210	TOP FLAT
G	OUTLET/DRAIN	3" INNER TANK BOSS FITTING WITH TRANSITION FITTING, CONTAINMENT, FLEX EXP JT. AND 3" PVC FLANGE	270	270	LOWER SIDEWALL
H	OVERFLOW	3" NOZZLE FITTING AND OVERFLOW PIPE	120	60	SIDE FLAT
I	U-VENT	8" U-VENT WITH INSECT SCREEN	120	60	TOP FLAT

DUAL-WALL BULK SODIUM HYPOCHLORITE TANK NOZZLE DETAIL

REV	ISSUED FOR	DATE	BY
1	ADDENDUM NO. 3	03/2026	

PROJECT ENGINEER:	J. BOWDAN
DESIGNED BY:	A. QIU
DRAWN BY:	J. COPPOLA
CHECKED BY:	P. COOKE

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE 0 1/2" 1"

Hazen
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HOLLYWOOD, FL 33021

CITY OF HOLLYWOOD
HOLLYWOOD, FLORIDA

SODIUM HYPOCHLORITE
TEMPORARY STORAGE AND FEED SYSTEM

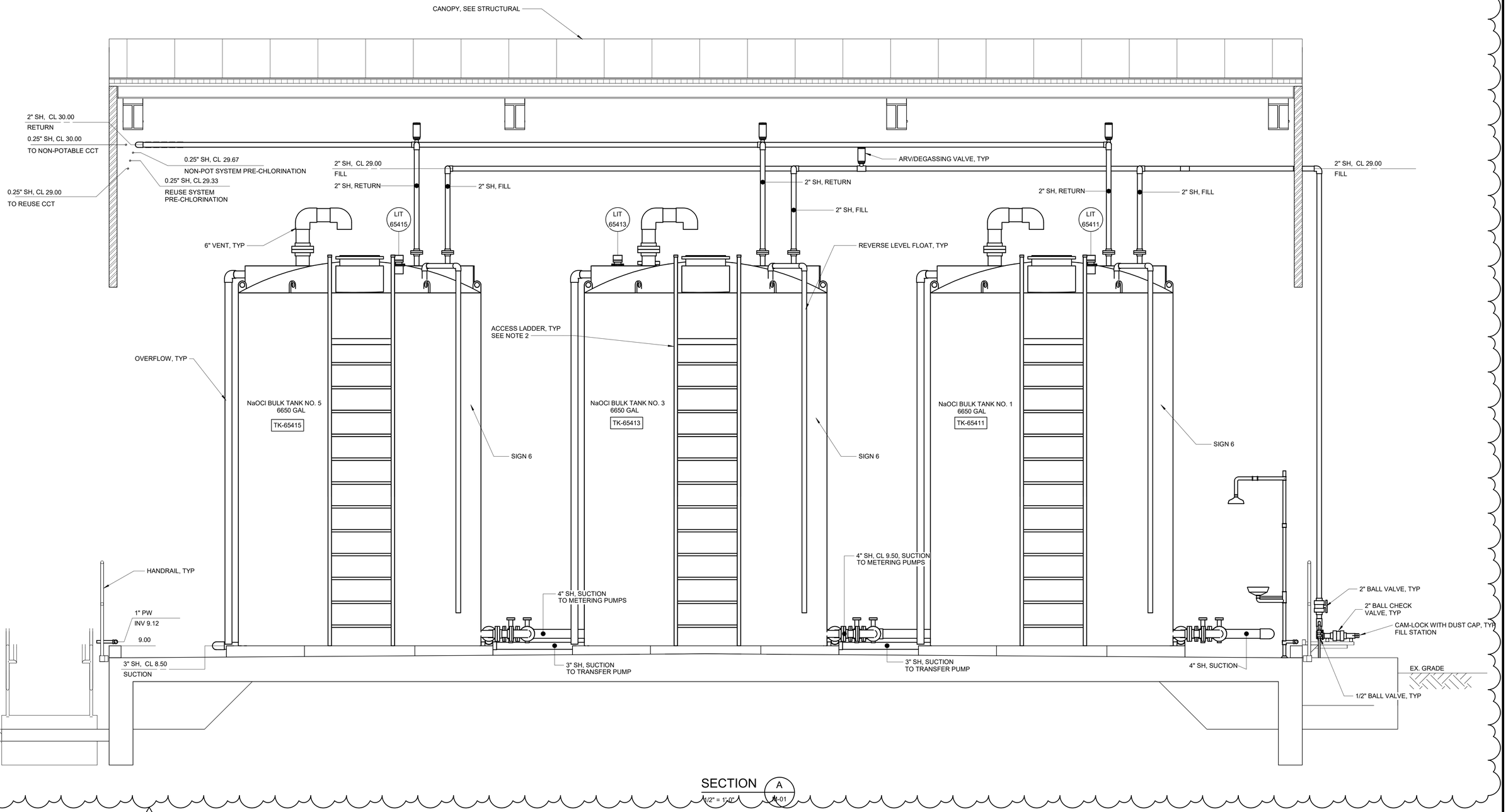
MECHANICAL
TEMPORARY HYPOCHLORITE SYSTEM
ENLARGED PLAN

DATE:	DECEMBER 2025
PROJECT NO.:	4321-111
CONTRACT NO.:	22-8073
DRAWING NUMBER:	M-01

Autodesk Docs://04321-111/04321-111-100-M.rvt
3/13/2026 6:11:34 PM

NOTES:

1. PIPE SUPPORTS NOT SHOWN FOR CLARITY, SEE M-18.
2. FALL-ARREST SYSTEM SHALL BE INCOPERATED INTO THE LADDER, SEE SPECFICATIONS FOR REQUIREMENTS.



SECTION A
1/2" = 1'-0"
M-01

1

REV	ISSUED FOR	DATE	BY
1	ADDENDUM NO. 3	03/2026	

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE (0, 1/2", 1")

PROJECT ENGINEER:	J. BOWDAN
DESIGNED BY:	A. QIU
DRAWN BY:	J. COPPOLA
CHECKED BY:	P. COOKE

Hazen
HAZEN AND SAWYER
4000 HOLLYWOOD BLVD SUITE 750N
HOLLYWOOD, FL 33021

CITY OF HOLLYWOOD
HOLLYWOOD, FLORIDA

SODIUM HYPOCHLORITE
TEMPORARY STORAGE AND FEED SYSTEM

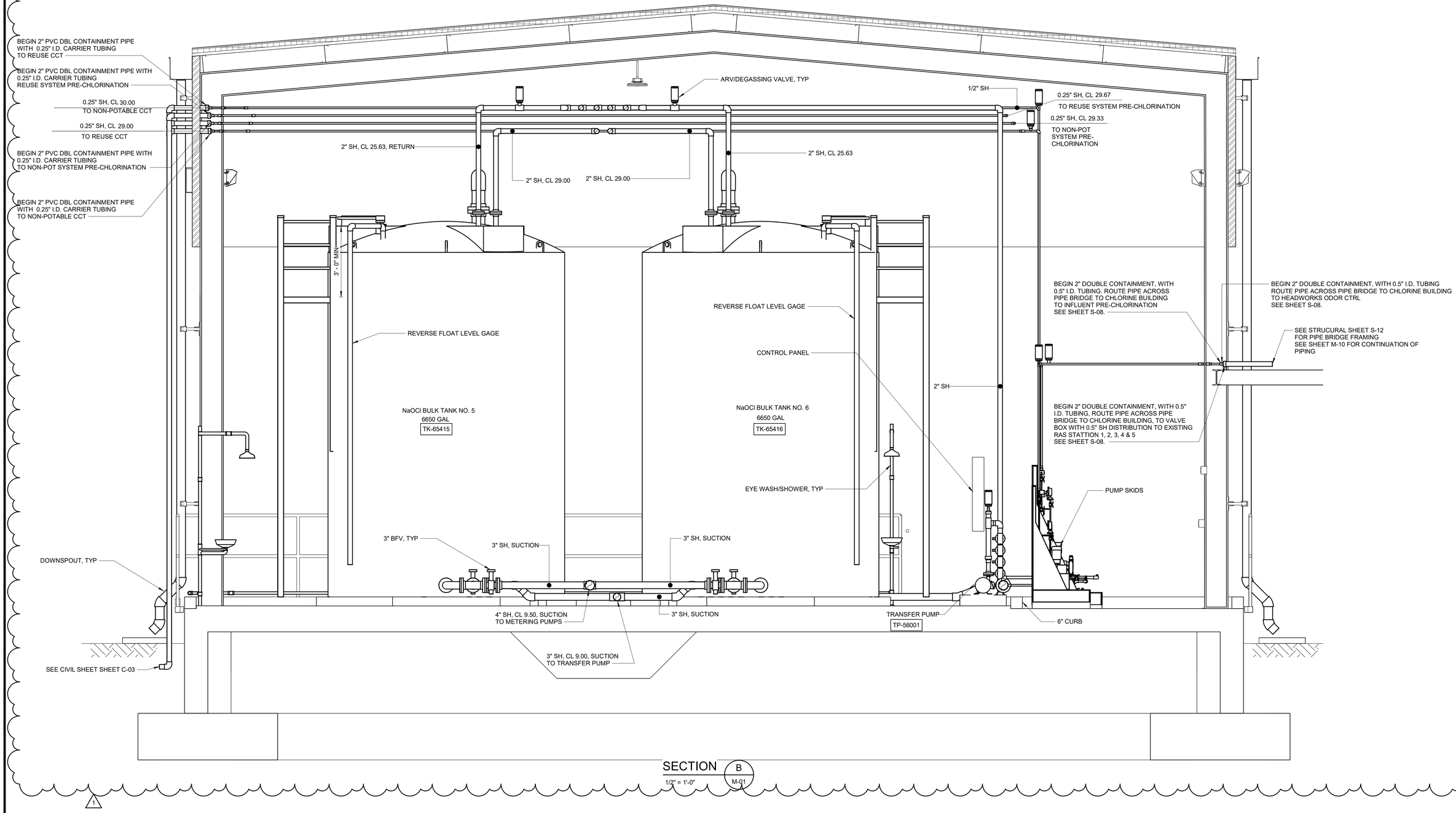
MECHANICAL
TEMPORARY HYPOCHLORITE SYSTEM
SECTIONS 1

DATE:	DECEMBER 2025
PROJECT NO.:	4321-111
CONTRACT NO.:	22-8073
DRAWING NUMBER:	M-02

Autodesk Docs://4321-111/4321-111-100-M.rvt
3/13/2026 6:11:35 PM

NOTES:

1. PIPE SUPPORTS NOT SHOWN FOR CLARITY, SEE M-18.



SECTION B M-01

1/2" = 1'-0"

1

REV	ISSUED FOR	DATE	BY
1	ADDENDUM NO. 3	03/2026	

PROJECT ENGINEER:	J. BOWDAN
DESIGNED BY:	A. QIU
DRAWN BY:	J. COPPOLA
CHECKED BY:	P. COOKE

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE 0 1/2" 1"

Hazen

HAZEN AND SAWYER
4000 HOLLYWOOD BLVD SUITE 750N
HOLLYWOOD, FL 33021

CITY OF HOLLYWOOD
HOLLYWOOD, FLORIDA

SODIUM HYPOCHLORITE
TEMPORARY STORAGE AND FEED SYSTEM

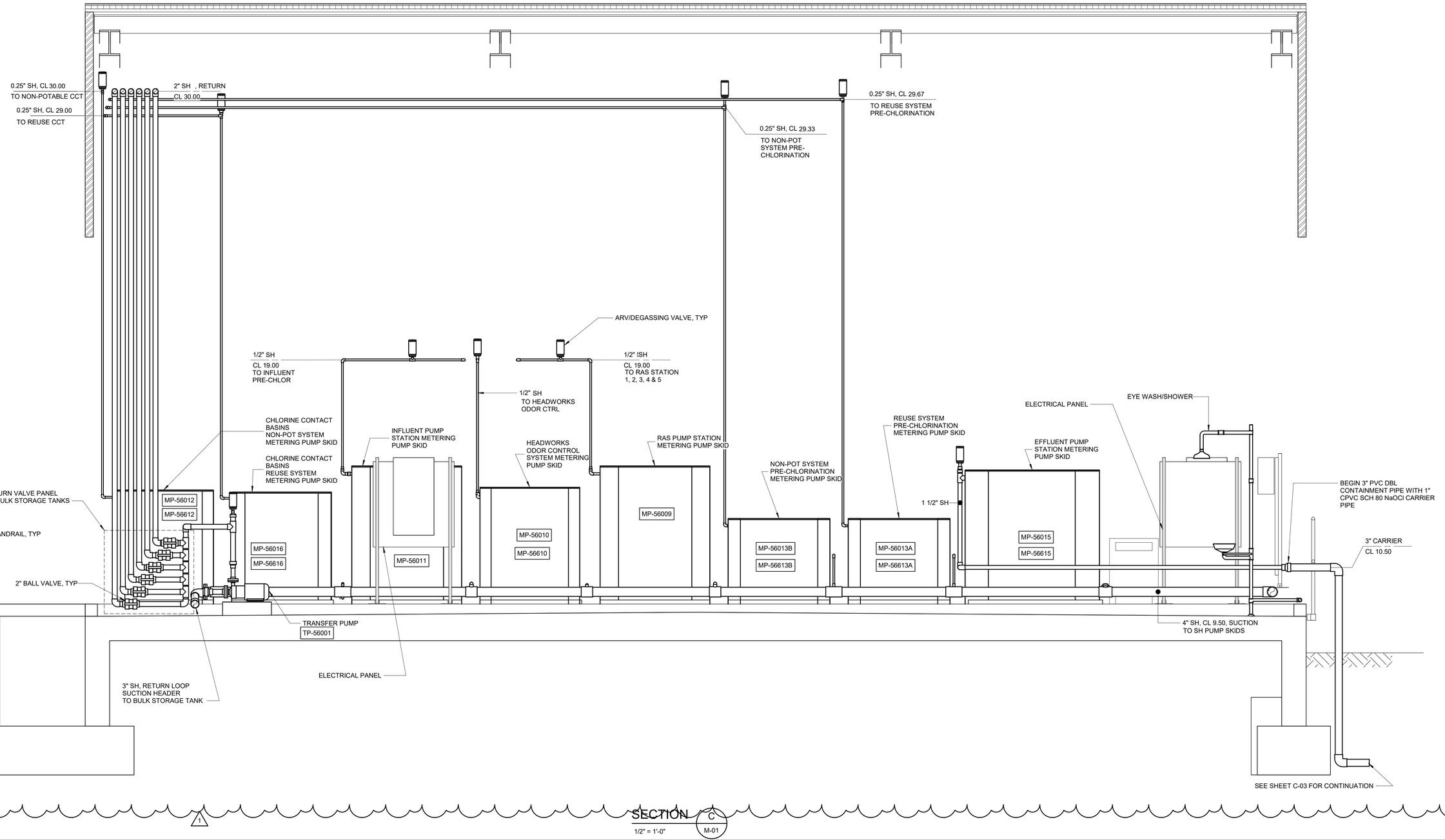
MECHANICAL
TEMPORARY HYPOCHLORITE SYSTEM
SECTIONS 2

DATE:	DECEMBER 2025
PROJECT NO.:	4321-111
CONTRACT NO.:	22-8073
DRAWING NUMBER:	M-03

Autodesk Docs://04321-111/04321-111-100-M.rvt
3/13/2026 6:11:38 PM

NOTES:

1. PIPE SUPPORTS NOT SHOWN FOR CLARITY, SEE M-18.
2. INSTALL RETURN VALVE PANEL ON 1" THICK HDPE PANEL BOARD. CUT TO FIT.



SECTION C
1/2" = 1'-0"
M-01

REV	ISSUED FOR	DATE	BY
1	ADDENDUM NO. 3	03/2026	

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE (0, 1/2", 1")

PROJECT ENGINEER:	J. BOWDAN
DESIGNED BY:	A. QIU
DRAWN BY:	J. COPPOLA
CHECKED BY:	P. COOKE

Hazen
HAZEN AND SAWYER
4000 HOLLYWOOD BLVD SUITE 750N
HOLLYWOOD, FL 33021

CITY OF HOLLYWOOD
HOLLYWOOD, FLORIDA

SODIUM HYPOCHLORITE
TEMPORARY STORAGE AND FEED SYSTEM

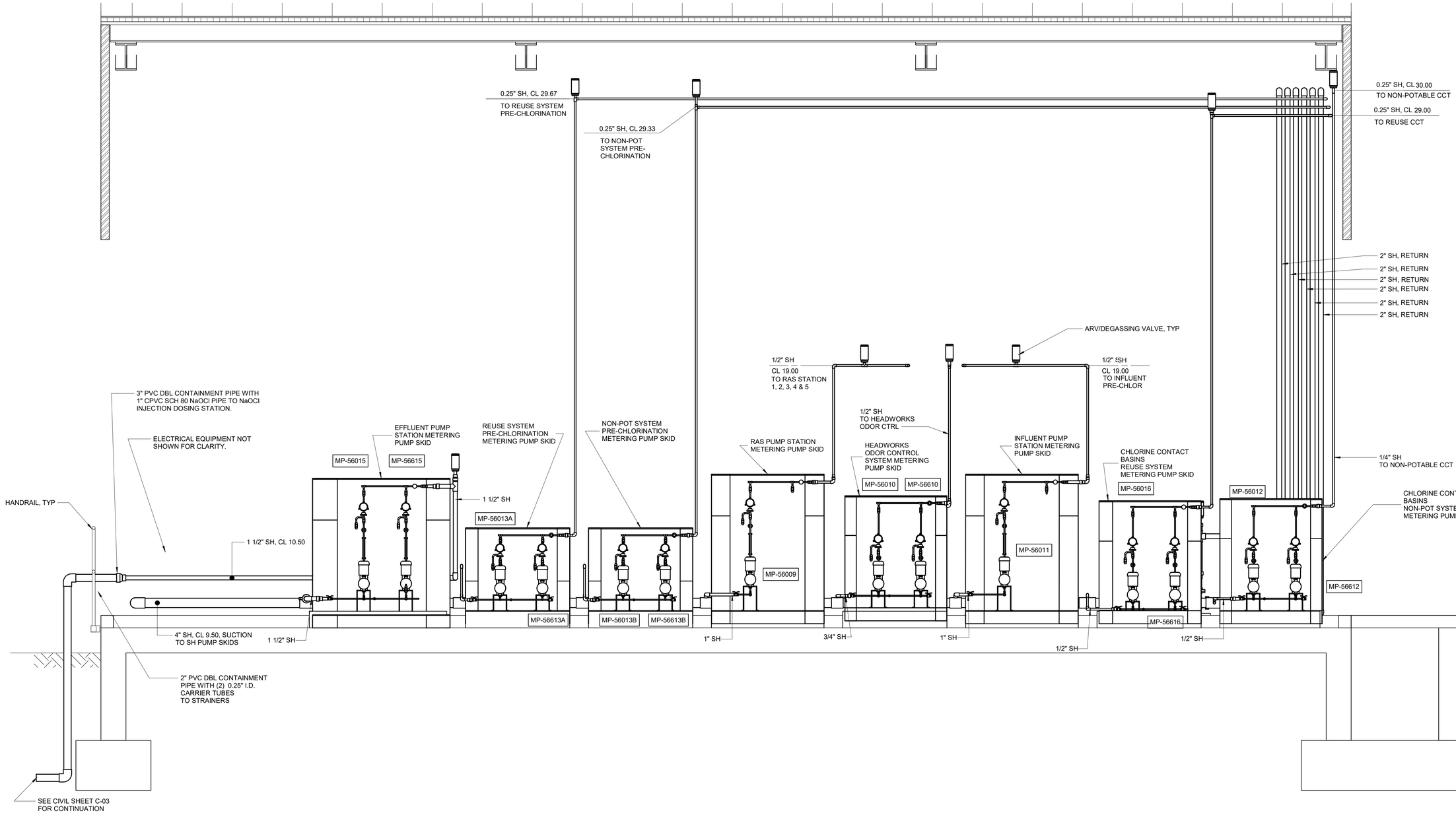
MECHANICAL
TEMPORARY HYPOCHLORITE SYSTEM
SECTIONS 3

DATE:	DECEMBER 2025
PROJECT NO.:	4321-111
CONTRACT NO.:	22-8073
DRAWING NUMBER:	M-04

Autodesk Docs://04321-111/04321-111-100-M.rvt
3/13/2026 6:11:39 PM

NOTES:

1. PIPE SUPPORTS NOT SHOWN FOR CLARITY, SEE M-18.



SECTION D
1/2" = 1'-0"
M-01

1

REV	ISSUED FOR	DATE	BY
1	ADDENDUM NO. 3	03/2026	

PROJECT ENGINEER:	J. BOWDAN
DESIGNED BY:	A. QIU
DRAWN BY:	J. COPPOLA
CHECKED BY:	P. COOKE

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE 0 1/2" 1"

Hazen
HAZEN AND SAWYER
4000 HOLLYWOOD BLVD SUITE 750N
HOLLYWOOD, FL 33021

CITY OF HOLLYWOOD
HOLLYWOOD, FLORIDA

SODIUM HYPOCHLORITE
TEMPORARY STORAGE AND FEED SYSTEM

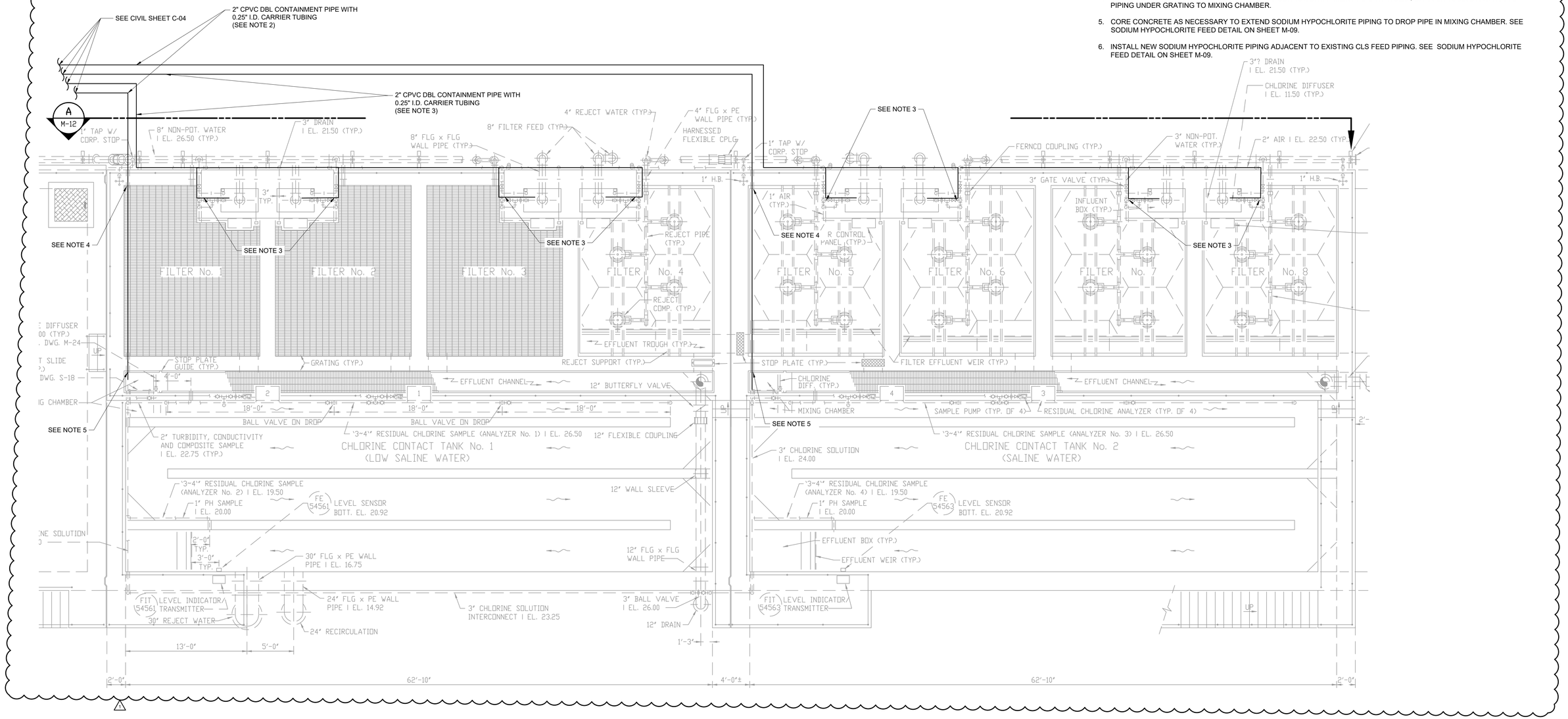
MECHANICAL
TEMPORARY HYPOCHLORITE SYSTEM
SECTIONS 4

DATE:	DECEMBER 2025
PROJECT NO.:	4321-111
CONTRACT NO.:	22-8073
DRAWING NUMBER:	M-05

Autodesk Docs://04321-111/04321-111-100-M.rvt
3/13/2026 6:11:40 PM

NOTES:

1. EXISTING UNDERGROUND UTILITIES SHOWN ON THIS SHEET ARE APPROXIMATELY LOCATED. CONTRACTOR SHALL POTHOLE EXISTING UTILITIES AS NECESSARY TO AVOID CONFLICT WITH NEW BURIED PIPING. CONTRACTOR SHALL BE RESPONSIBLE TO MAKE ALIGNMENT ADJUSTMENT WITH NEW BURIED PIPING AS NECESSARY TO AVOID CONFLICT WITH EXISTING UTILITIES.
2. INSTALL NEW 2" CPVC SCH 40 CONTAINMENT PIPE WITH 0.25", CARRIER TUBING (PER PLAN) FROM TEMPORARY HYPOCHLORITE SYSTEM TO MIXING CHAMBER AT THE START OF THE CHLORINE CONTACT TANKS.
3. INSTALL NEW 2" CPVC SCH 40 CONTAINMENT PIPE WITH 0.25", CARRIER TUBING (PER PLAN) FROM TEMPORARY HYPOCHLORITE SYSTEM TO INFLUENT BOX AT THE START OF THE FILTERS. 0.25" TUBING REDUCE TO 1/8" AT THE ROTAMETER, THEN BACK TO 1/4" UNTIL THE 0.5" CVPV SCH 80 DROP PIPE. REFER TO SPEC SECTION 40 71 43 FOR ROTAMETERS INFORMATION.
4. CUT GRATING TO ACCOMMODATE NEW 2" CPVC SCH 40 CONTAINMENT PIPE WITH 0.25", CARRIER TUBING AND ROUTE PIPING UNDER GRATING TO MIXING CHAMBER.
5. CORE CONCRETE AS NECESSARY TO EXTEND SODIUM HYPOCHLORITE PIPING TO DROP PIPE IN MIXING CHAMBER. SEE SODIUM HYPOCHLORITE FEED DETAIL ON SHEET M-09.
6. INSTALL NEW SODIUM HYPOCHLORITE PIPING ADJACENT TO EXISTING CLS FEED PIPING. SEE SODIUM HYPOCHLORITE FEED DETAIL ON SHEET M-09.



PLAN 1
SCALE: 3/16" = 1' C-03,04

REV	ISSUED FOR	DATE	BY
1	ADDENDUM NO. 3	03/2026	

PROJECT ENGINEER:	J. BOWDAN
DESIGNED BY:	M. GONZALEZ
DRAWN BY:	J. COPPOLA
CHECKED BY:	P. COOKE

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE 0 1/2" 1"

Hazen
HAZEN AND SAWYER
4000 HOLLYWOOD BLVD SUITE 750N
HOLLYWOOD, FL 33021

CITY OF HOLLYWOOD
HOLLYWOOD, FLORIDA

SODIUM HYPOCHLORITE
TEMPORARY STORAGE AND FEED SYSTEM

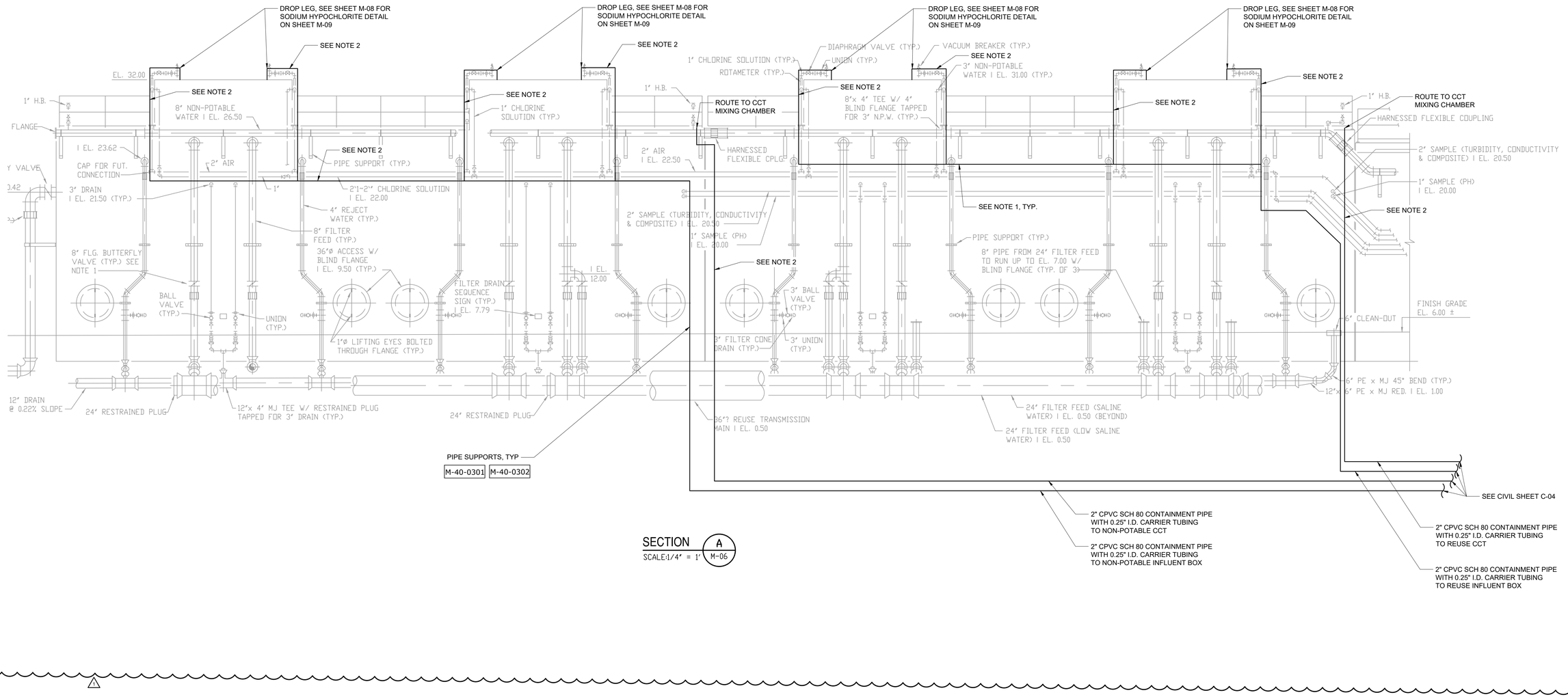
MECHANICAL
REUSE FILTERS AND CHLORINE CONTACT TANKS ENLARGED PLAN

DATE:	MARCH 2026
HAZEN NO.:	4321-111
CONTRACT NO.:	22-8073
DRAWING NUMBER:	M-06

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PLOT DATE: 3/13/2026 6:46 PM BY: JCOPPOLA

NOTES:

1. SEE DRAWING M-16 FOR PIPES SUPPORTS. M-40-0301 AND M-40-0302
2. ROUTE DOUBLE CONTAINMENT PIPING ABOVE GROUND TO ROTAMETER OR DROP LEG LOCATIONS



SECTION A
SCALE:1/4" = 1' (A / M-06)

REV	ISSUED FOR	DATE	BY
1	ADDENDUM NO. 3	03/2026	

PROJECT ENGINEER:	J. BOWDAN
DESIGNED BY:	M. GONZALEZ
DRAWN BY:	J. COPPOLA
CHECKED BY:	P. COOKE

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE (0 1/2" 1")

Hazen
HAZEN AND SAWYER
4000 HOLLYWOOD BLVD SUITE 750N
HOLLYWOOD, FL 33021

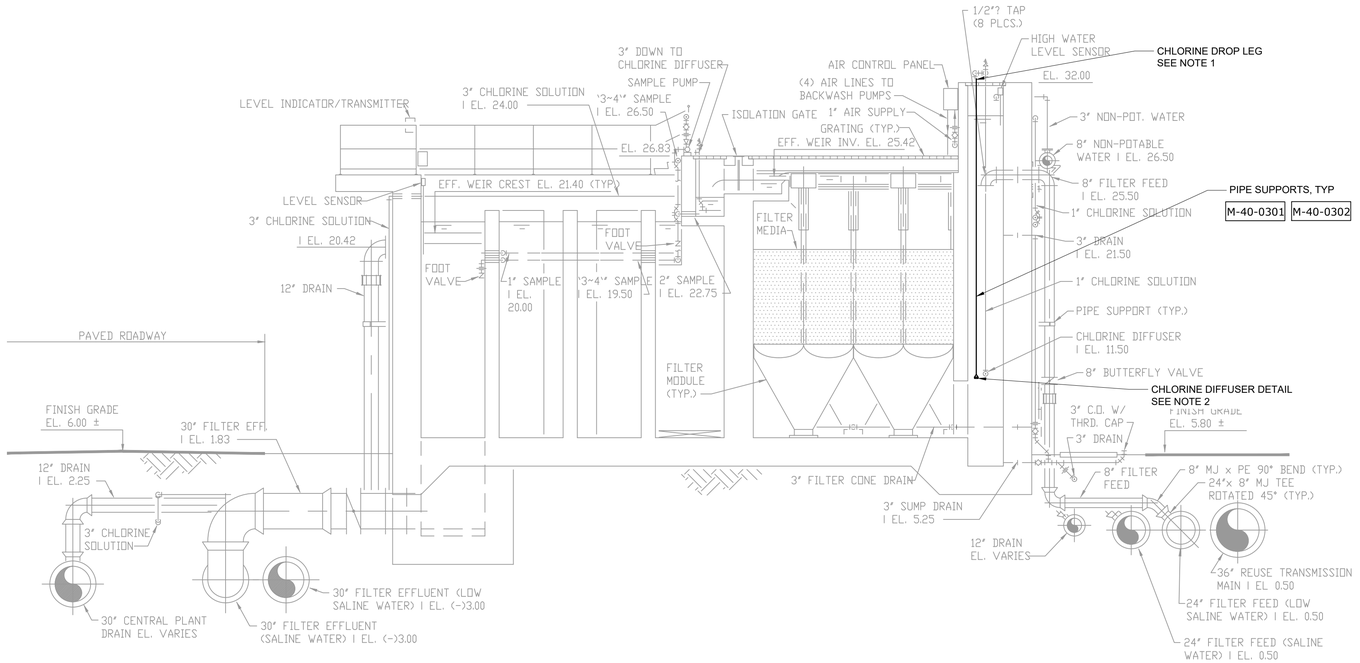
CITY OF HOLLYWOOD
HOLLYWOOD, FLORIDA

SODIUM HYPOCHLORITE
TEMPORARY STORAGE AND FEED SYSTEM

MECHANICAL
REUSE FILTERS AND CHLORINE CONTACT TANKS SECTION 1

DATE:	MARCH 2026
HAZEN NO.:	4321-111
CONTRACT NO.:	22-8073
DRAWING NUMBER:	M-07

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PLOT DATE: 3/13/2026 6:46 PM BY: JCOPPOLA



SECTION A
SCALE:1/4" = 1' (M-07)

NOTES:

1. SEE CHLORINE FEED DETAIL ON SHEET M-09 FOR PIPING ARRANGEMENT. CONSTRUCT NEW CHLORINE PIPING ADJACENT TO EXISTING CHLORINE SOLUTION PIPING.
2. SEE CHLORINE DIFFUSER DETAIL ON SHEET M-09 FOR DIFFUSER ARRANGEMENT. CONSTRUCT NEW CHLORINE PIPING ADJACENT TO EXISTING CHLORINE SOLUTION PIPING.

REV	ISSUED FOR	DATE	BY
1	ADDENDUM NO. 3	03/2026	

PROJECT ENGINEER:	J. BOWDAN
DESIGNED BY:	M. GONZALEZ
DRAWN BY:	J. COPPOLA
CHECKED BY:	P. COOKE

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE (0, 1/2", 1")

Hazen
HAZEN AND SAWYER
4000 HOLLYWOOD BLVD SUITE 750N
HOLLYWOOD, FL 33021

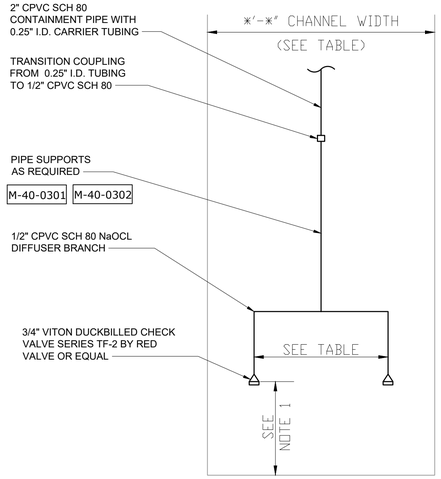
CITY OF HOLLYWOOD
HOLLYWOOD, FLORIDA

SODIUM HYPOCHLORITE
TEMPORARY STORAGE AND FEED SYSTEM

MECHANICAL
REUSE FILTERS AND CHLORINE CONTACT
TANKS SECTION 2

DATE:	MARCH 2026
HAZEN NO.:	4321-111
CONTRACT NO.:	22-8073
DRAWING NUMBER:	M-08

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PLOT DATE: 3/13/2026 6:46 PM BY: JCOPPOLA



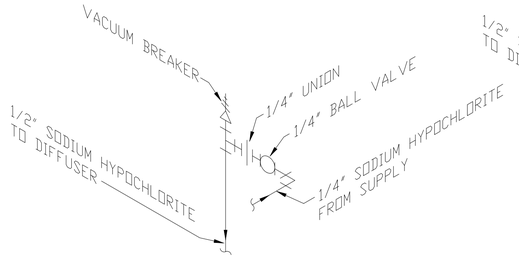
	CCT MIXING CHAMBER	FILTER INFLUENT BOX
* CHANNEL WIDTH	2'-0"	4'-0"
DROP PIPE SIZE	1/2" DIA	1/2" DIA
NOZZLE AND CHECK VALVE SIZE	3/4"	3/4"
CHECK VALVE SPACING	8"	16"
NUMBER REQUIRED	2	8

NOTES
1. OPENING ELEVATION OF DUCKBILLED CHECK VALVE SHALL MATCH EXISTING ORIFICE OF PVC SCH 80 DIFFUSER

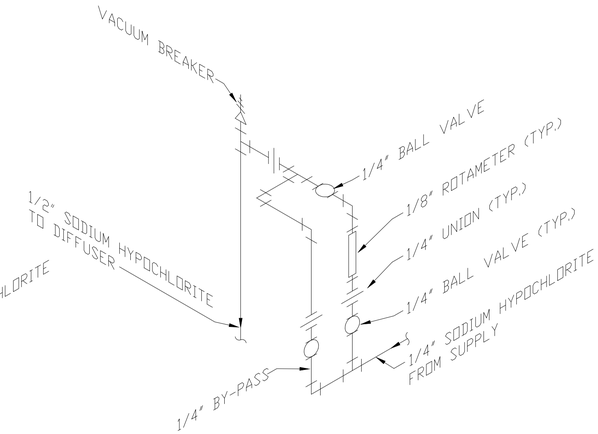
SODIUM HYPOCHLORITE DROP PIPE & DIFFUSER DETAIL
SCALE:NONE

NOTES:

1. PIPING ASSEMBLY ABOVE CHLORINE CONTACT TANK MIXING CHAMBER AND FILTER INFLUENT BOX AS SHOWN IN THE CHLORINE SOLUTION FEED DETAIL SHALL BE CONSTRUCTED ADJACENT TO EXISTING CHLORINE SOLUTION PIPING.



AT CHLORINE CONTACT TANK MIXING CHAMBER



AT FILTER INFLUENT BOX

FILTER NUMBER	ROTAMETER NUMBER
1	FL XXX
2	FL X
3	FL X
4	FL X
5	FL X
6	FL X
7	FL X
8	FL X

NOTE:
SEE DIFFUSER DETAIL THIS SHEET

SODIUM HYPOCHLORITE FEED DETAIL
SCALE:NONE

REV	ISSUED FOR	DATE	BY
1	ADDENDUM NO. 3	03/2026	

PROJECT ENGINEER: J. BOWDAN
DESIGNED BY: M. GONZALEZ
DRAWN BY: J. COPPOLA
CHECKED BY: P. COOKE
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE 0 1/2" 1"

Hazen
HAZEN AND SAWYER
4000 HOLLYWOOD BLVD SUITE 750N
HOLLYWOOD, FL 33021

CITY OF HOLLYWOOD
HOLLYWOOD, FLORIDA

SODIUM HYPOCHLORITE
TEMPORARY STORAGE AND FEED SYSTEM

MECHANICAL
REUSE FILTERS AND CHLORINE CONTACT TANKS DETAILS

DATE: MARCH 2026
HAZEN NO.: 4321-111
CONTRACT NO.: 22-8073
DRAWING NUMBER: M-09

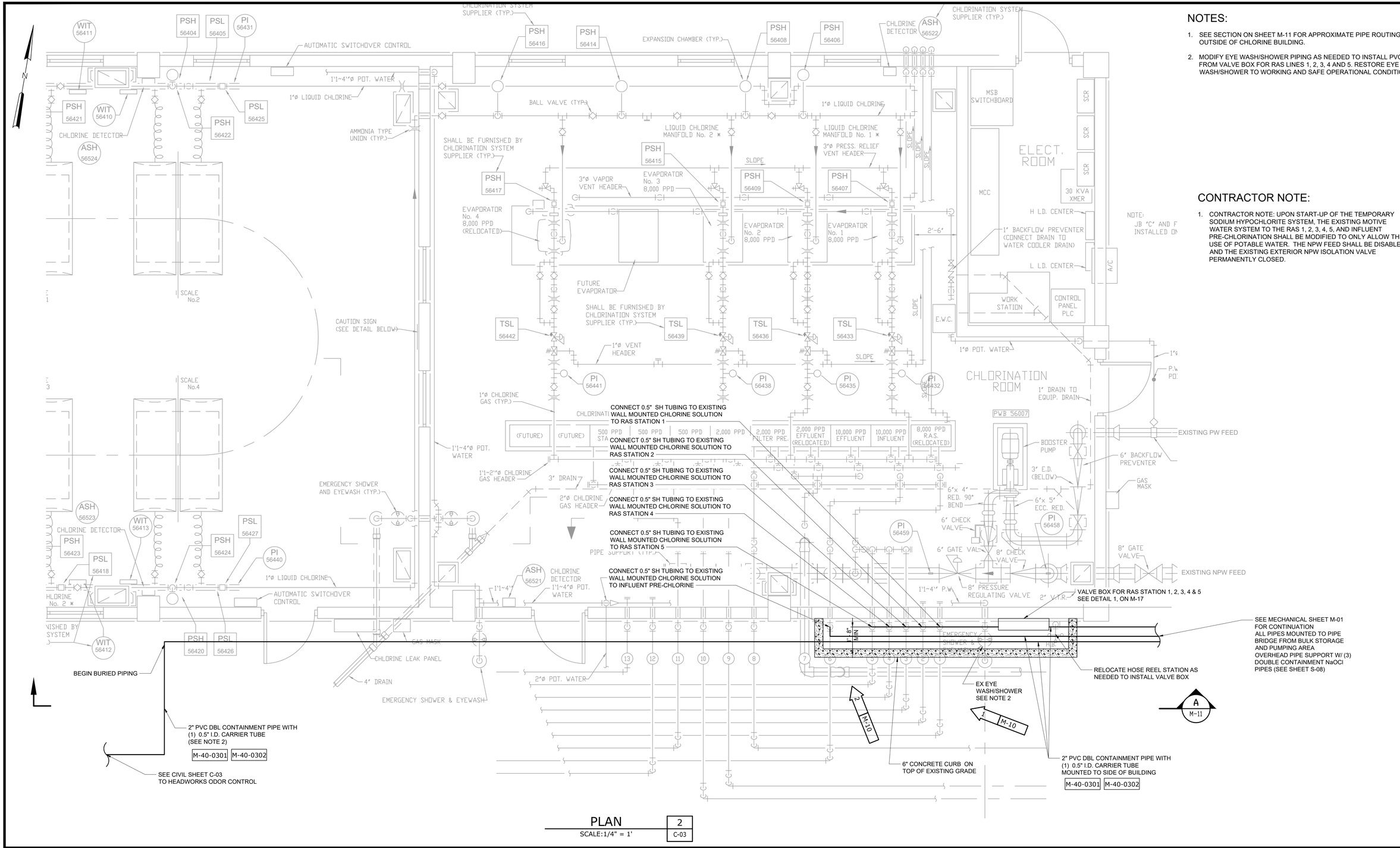
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PLOT DATE: 3/13/2026 6:46 PM BY: JCOPPOLA

NOTES:

1. SEE SECTION ON SHEET M-11 FOR APPROXIMATE PIPE ROUTING ALONG OUTSIDE OF CHLORINE BUILDING.
2. MODIFY EYE WASH/SHOWER PIPING AS NEEDED TO INSTALL PVC PIPING FROM VALVE BOX FOR RAS LINES 1, 2, 3, 4 AND 5. RESTORE EYE WASH/SHOWER TO WORKING AND SAFE OPERATIONAL CONDITION.

CONTRACTOR NOTE:

1. CONTRACTOR NOTE: UPON START-UP OF THE TEMPORARY SODIUM HYPOCHLORITE SYSTEM, THE EXISTING MOTIVE WATER SYSTEM TO THE RAS 1, 2, 3, 4, 5, AND INFLUENT PRE-CHLORINATION SHALL BE MODIFIED TO ONLY ALLOW THE USE OF POTABLE WATER. THE NPW FEED SHALL BE DISABLE AND THE EXISTING EXTERIOR NPW ISOLATION VALVE PERMANENTLY CLOSED.



PLAN
SCALE:1/4" = 1'

2
C-03

REV	ISSUED FOR	DATE	BY

PROJECT ENGINEER:	J. BOWDAN
DESIGNED BY:	M. GONZALEZ
DRAWN BY:	J. COPPOLA
CHECKED BY:	P. COOKE

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE (0, 1/2", 1")

Hazen
HAZEN AND SAWYER
4000 HOLLYWOOD BLVD SUITE 750N
HOLLYWOOD, FL 33021

CITY OF HOLLYWOOD
HOLLYWOOD, FLORIDA

SODIUM HYPOCHLORITE
TEMPORARY STORAGE AND FEED SYSTEM

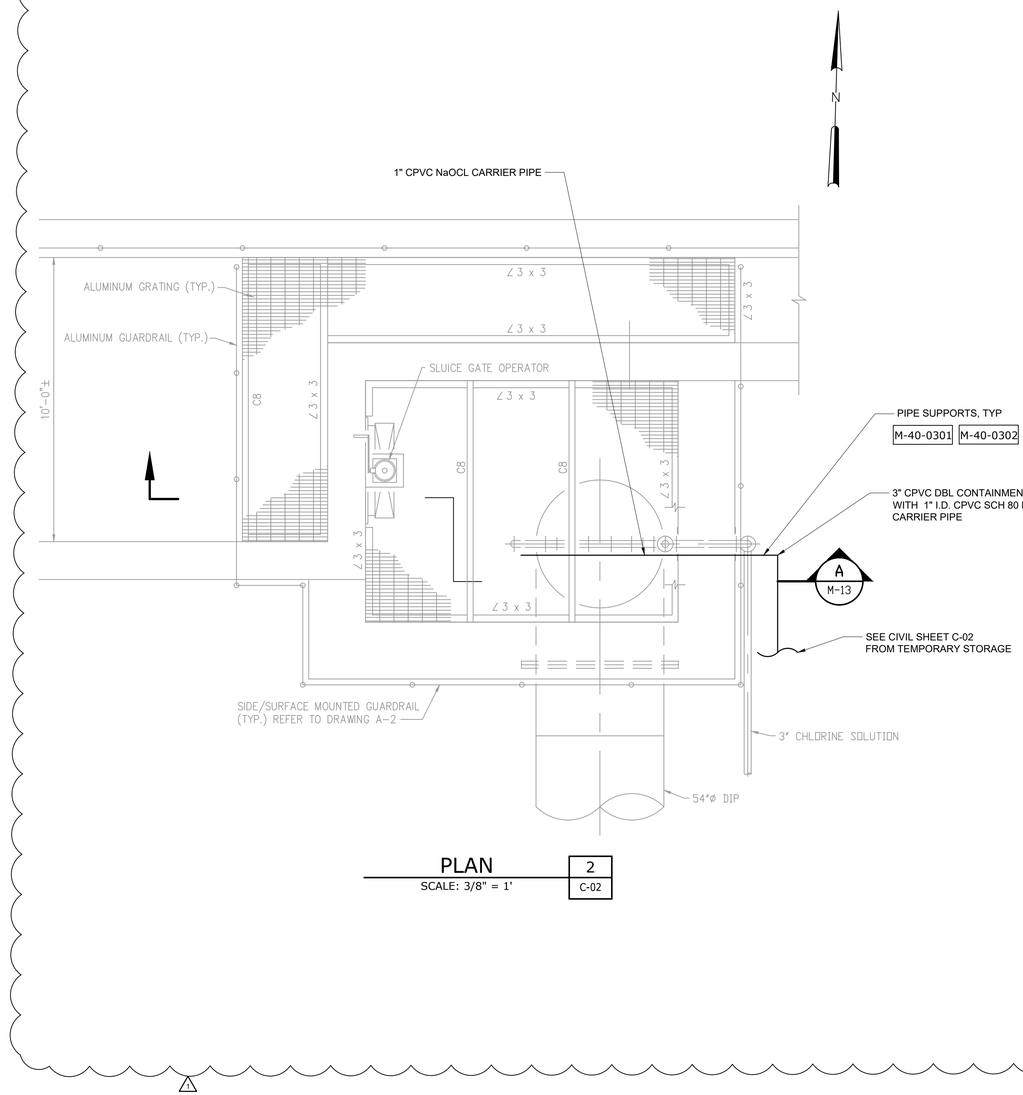
MECHANICAL
CHLORINE BUILDING PLAN

DATE:	MARCH 2026
HAZEN NO.:	4321-111
CONTRACT NO.:	22-8073
DRAWING NUMBER:	M-10

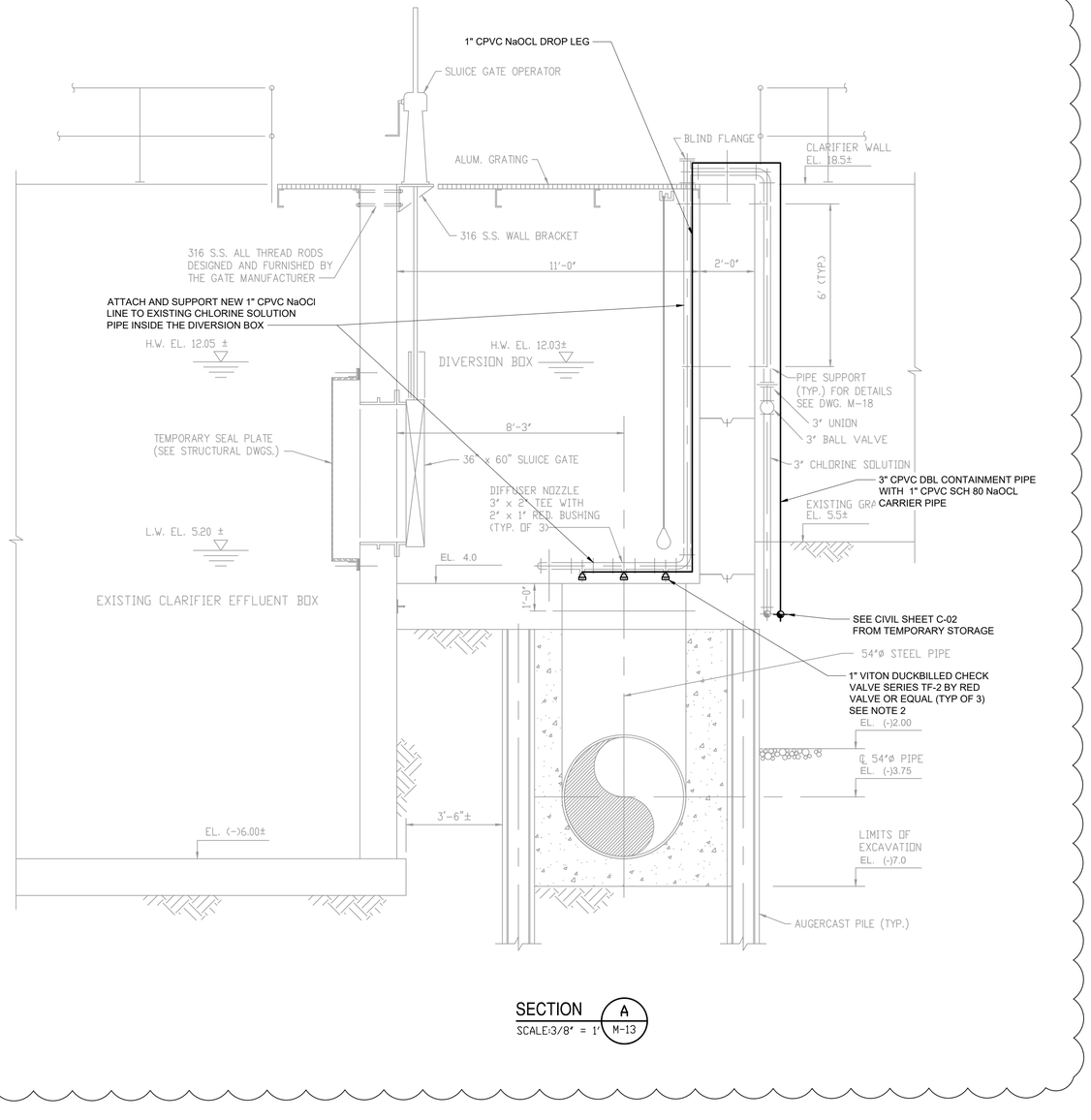
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PLOT DATE: 3/13/2026 6:46 PM BY: JCOPPOLA

NOTES:

1. SEE SPEC SECTION 01 14 00.
2. OPENING OF DUCKBILL CHECK VALVE SHALL MATCH THE EXISTING CHLORINE SOLUTION DIFFUSER 2"X1" PVC REDUCER OPENINGS OPENINGS.



PLAN | 2
SCALE: 3/8" = 1' | C-02



SECTION | A
SCALE:3/8" = 1' | M-13

REV	ISSUED FOR	DATE	BY
1	ADDENDUM NO. 3	03/2026	

PROJECT ENGINEER:	J. BOWDAN
DESIGNED BY:	M. GONZALEZ
DRAWN BY:	J. COPPOLA
CHECKED BY:	P. COOKE

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE — 0 1/2" 1"

Hazen
HAZEN AND SAWYER
4000 HOLLYWOOD BLVD SUITE 750N
HOLLYWOOD, FL 33021

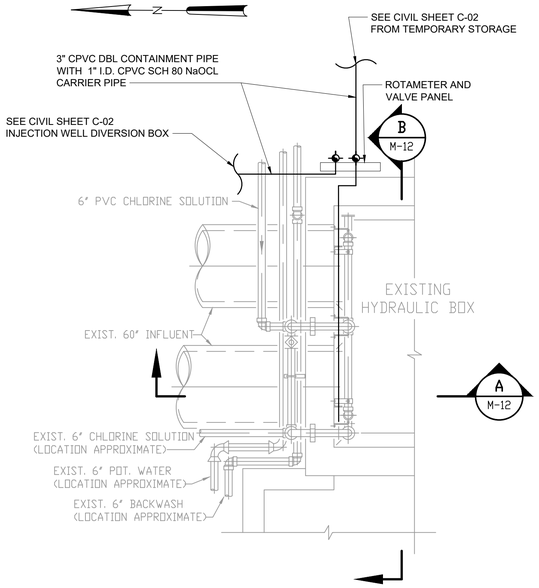
CITY OF HOLLYWOOD
HOLLYWOOD, FLORIDA

SODIUM HYPOCHLORITE
TEMPORARY STORAGE AND FEED SYSTEM

MECHANICAL
INJECTION POINT 7B INJECTION WELL
DIVERSION BOX PIPING DETAILS

DATE:	MARCH 2026
HAZEN NO.:	4321-111
CONTRACT NO.:	22-8073
DRAWING NUMBER:	M-13

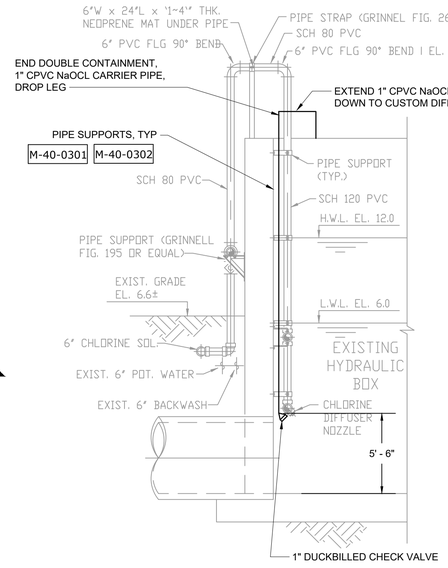
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PLOT DATE: 3/13/2026 6:47 PM BY: JCOPPOLA



PLAN

SCALE:3/16" = 1'

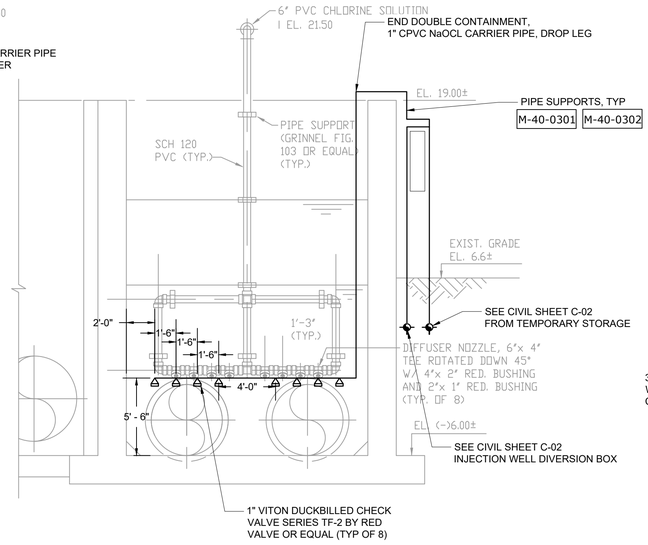
3 / C-02



SECTION A

SCALE:3/16" = 1'

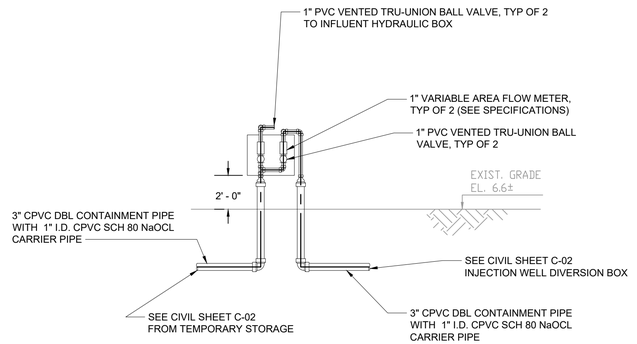
M-12



SECTION B

SCALE:3/16" = 1'

M-12



ROTAMETER AND VALVE PANEL DETAIL

SCALE: NONE

REV	ISSUED FOR	DATE	BY
1	ADDENDUM NO. 3	03/2026	

PROJECT ENGINEER:	J. BOWDAN
DESIGNED BY:	M. GONZALEZ
DRAWN BY:	J. COPPOLA
CHECKED BY:	P. COOKE

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE (0, 1/2", 1")

Hazen

HAZEN AND SAWYER
4000 HOLLYWOOD BLVD SUITE 750N
HOLLYWOOD, FL 33021

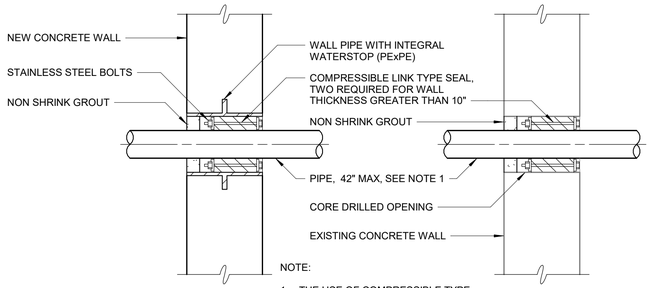
CITY OF HOLLYWOOD
HOLLYWOOD, FLORIDA

SODIUM HYPOCHLORITE
TEMPORARY STORAGE AND FEED SYSTEM

MECHANICAL
INJECTION POINT 7A HYDRAULIC BOX PIPING
DETAILS

DATE:	MARCH 2026
HAZEN NO.:	4321-111
CONTRACT NO.:	22-8073
DRAWING NUMBER:	M-14

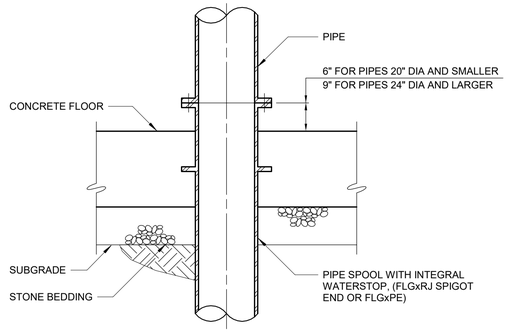
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PLOT DATE: 3/13/2026 6:47 PM BY: JCOPPOLA



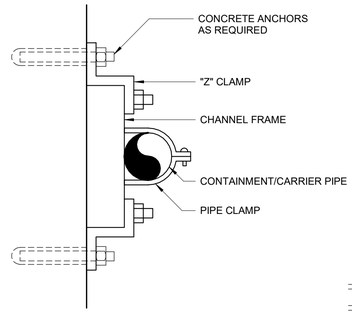
NOTE:

1. THE USE OF COMPRESSIBLE TYPE LINK SEALS ON PIPES LARGER THAN 42" REQUIRES ENGINEER'S APPROVAL.
2. PRIOR TO INSTALLATION OF LINK SEAL, BURN BACK REINFORCEMENT STEEL 1/2" MIN BELOW SURFACE AND FILL VOIDS CREATED WITH EPOXY RESIN BINDER.

M-40-0111



M-40-0113

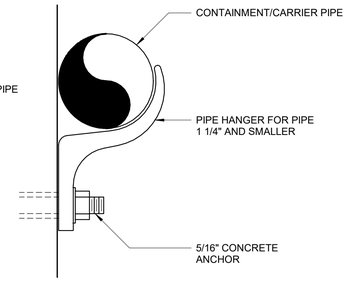


PIPE WALL SUPPORT AND SUPPORT RACK SHALL BE ASSEMBLED W/ CHANNEL FRAMES AND ACCESSORIES AS MANUFACTURED BY UNISTRUT CORP OR EQUAL

FOR ALL SH CONCENTRATE AND CHLORINE SOLUTION PIPING THE SUPPORTS SHALL BE CONSTRUCTED USING FRP "Z" CLAMPS CHANNEL FRAME AND PIPE CLAMPS.

PIPE WALL SUPPORT

M-40-0301



FOR ALL SH CONCENTRATE AND CHLORINE SOLUTION PIPING THE SUPPORTS SHALL BE CONSTRUCTED USING FRP PIPE HANGER.

WALL HANGER PIPE SUPPORT

M-40-0302

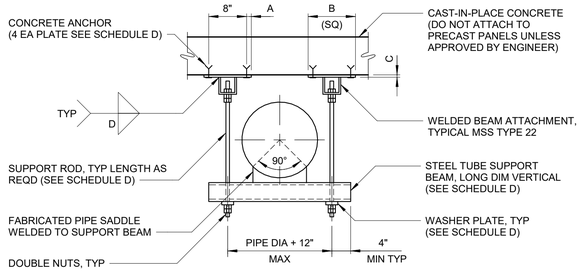
NOTES:

1. CONTRACTOR SHALL DESIGN THE SUPPORT SYSTEMS BASED ON ACTUAL WEIGHTS AND CONDITIONS AS SPECIFIED OR AS SHOWN ON THE CONTRACT DRAWINGS. PIPE HANGERS, SUPPORTS AND BRACKETS SHOWN HERE IN VARIOUS COMBINATIONS REPRESENT MINIMUM REQUIREMENTS FOR ACCEPTABLE SUPPORTS AS TO TYPES, MATERIALS, THICKNESSES, ORIENTATION, AND QUALITY. CONTRACTOR SHALL SUBMIT DESIGN CALCULATIONS AND DETAILS FOR PIPE SUPPORTS SEALED BY A PROFESSIONAL ENGINEER LICENSED BY THE STATE WHERE THE PROJECT IS LOCATED WITH ALL PIPE HANGER AND SUPPORT SUBMISSIONS FOR REVIEW BY THE ENGINEER. WHEN SUBMITTING PROPOSED PIPE SUPPORTS AND SUPPORT LOCATIONS, THE CONTRACTOR SHALL USE APPROVED PIPING LAYOUT SUBMITTAL DRAWINGS TO SHOW PROPOSED PIPE SUPPORT TYPE AND LOCATION WITH ACCURATE DIMENSIONS TO DEMONSTRATE THAT SUPPORTS DO NOT EXCEED THE MAXIMUM SPACING REQUIREMENTS OF SECTION 40 05 07. THIS ENSURES THAT SUPPORTS HAVE BEEN COORDINATED WITH ACTUAL PIPE INSTALLATION DRAWINGS. AND THAT SPACING DOES NOT EXCEED MAXIMUM ALLOWABLE SPACING. THE PIPE SUPPORTS SHOWN AND REFERENCED UNDER SCHEDULES A, B & C ARE DESIGNED AND DETAILED FOR GRAVITY LOADING ONLY. RESULTING LATERAL LOADS FROM CONSTRUCTION CONDITIONS, DESIGN SEISMIC EVENT OR OTHER RELATED CONDITIONS SHALL BE APPLIED TO THE PIPE AND OTHER NON-STRUCTURAL COMPONENTS IN ACCORDANCE WITH THE GOVERNING BUILDING CODE. SUPPLEMENTAL LATERAL STIFFNESS, RESISTANCE AND MEMBERS (WHEN NECESSARY) SHALL BE PROVIDED ALONG PIPE OR AT GRAVITY SUPPORTS AND CONNECTIONS WHEN REQUIRED BY CALCULATIONS.
2. TYPICALLY, REINFORCED CONCRETE SUPPORTS SHALL BE USED WHEN PIPE CENTERLINE IS LESS THAN 3-FEET ABOVE CONCRETE FLOOR OR FINISHED GRADE, AND AT A MINIMUM, SHALL CONFORM TO STANDARD DETAIL S-03-0504.
3. MSS REFERS TO THE MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY, STANDARD PRACTICE SP-58 AND SP-69
4. PIPE WALL SUPPORT AND PIPE SUPPORT RACK SHALL BE ASSEMBLED WITH CHANNEL FRAMES AND ACCESSORIES AS MANUFACTURED BY UNISTRUT CORP, OR VERSABAR CORP, OR EQUAL.
5. FABRICATED PIPE SUPPORT MAY BE USED AS SHOWN IN PIPE SUPPORT RACK DETAIL, OR TO SUPPORT PIPE FROM THE FLOOR.

SCHEDULE D

TRAPEZE SUPPORT (DIM IN INCHES)

PIPE SIZE	STEEL TUBE SUPPORT BEAM VERT x HOR	MINIMUM ROD Ø (INCHES)		WASHER PLATE	BASE PLATE			WELD	CONCRETE ANCHOR DIA	MAX SUPPORT SPACING IN FEET (SEE NOTE 8)	
		PROCESS PIPING	STEEL AIR PIPING		A	B	C	D		PROCESS PIPING	STEEL AIR PIPING
12-14	4x4x3/8	1/2	1/2	4x4x1/4	1	10	3/8	3/16	1/2	10	15
16-24	4x4x3/8	3/4	5/8	4x4x3/8	1	10	1/2	3/16	5/8	10	15
30-36	6x4x3/8	1	3/4	4x4x1/2	2	12	1/2	1/4	3/4	10	20
42	6x4x3/8	1 1/4	3/4	5x5x1/2	2	12	3/4	1/4	7/8	10	25
48	8x4x3/8	1 1/2	1	5x5x3/4	2	12	1	1/4	1	10	30

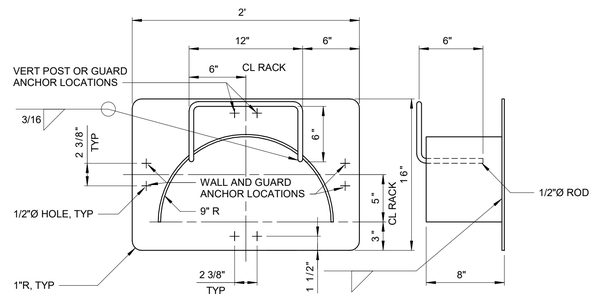


TRAPEZE SUPPORT

M-40-0310

HOSE BIBB

M-40-0704

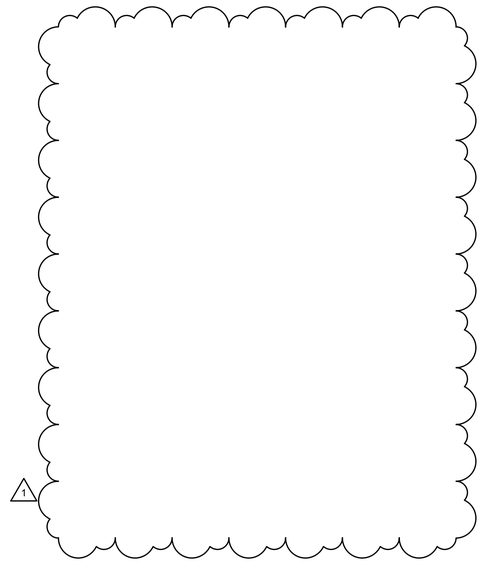


NOTES:

1. ALL MATERIAL TO BE 304 STAINLESS STEEL. ANNEAL ASSEMBLY AFTER FABRICATION.
2. CHAMFER, GRIND, DEBURR ALL METAL EDGES FOR SMOOTH CONTOUR.
3. ATTACH TO GUARD WITH 316 STAINLESS STEEL U-BOLTS, NUTS AND WASHERS.

HOSE RACK

M-40-0707



REV	ISSUED FOR	DATE	BY
1	ADDENDUM NO. 3	03/2026	

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE 0 1/2" 1"

PROJECT ENGINEER:	J. BOWDAN
DESIGNED BY:	A. QIU
DRAWN BY:	J. COPPOLA
CHECKED BY:	P. COOKE

Hazen

HAZEN AND SAWYER
4000 HOLLYWOOD BLVD SUITE 750N
HOLLYWOOD, FL 33021

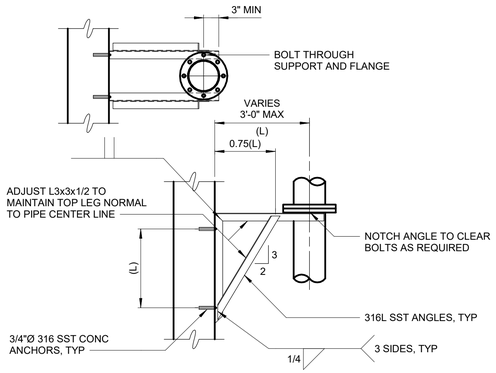
CITY OF HOLLYWOOD
HOLLYWOOD, FLORIDA

SODIUM HYPOCHLORITE
TEMPORARY STORAGE AND FEED SYSTEM

MECHANICAL
TYPICAL DETAILS 1

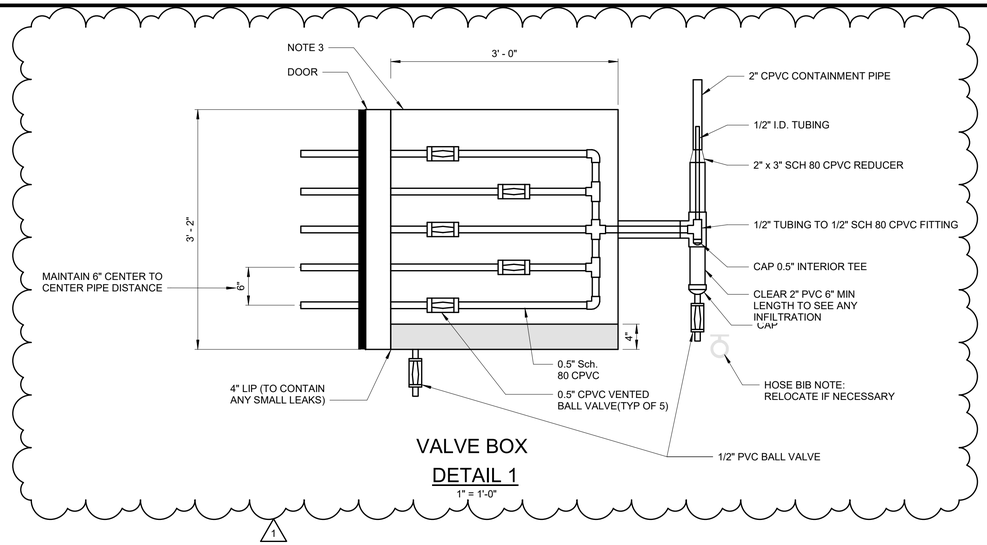
DATE:	MARCH 2026
PROJECT NO.:	4321-111
CONTRACT NO.:	22-8073
DRAWING NUMBER:	M-16

Autodesk Docs://04321-111/details.rvt
3/16/2026 4:46:03 PM



FLANGE TYPE SUPPORT

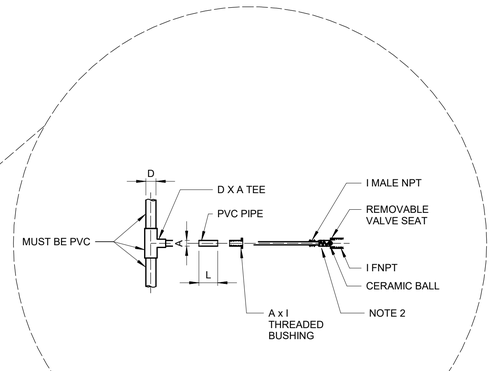
M-40-0311

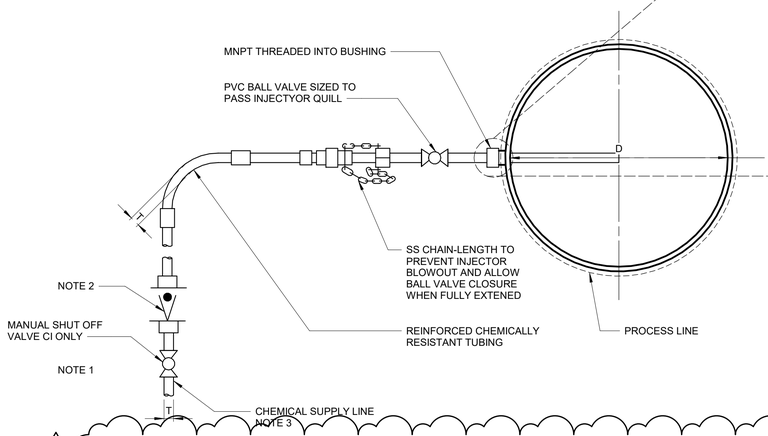


VALVE BOX

DETAIL 1

1" = 1'-0"





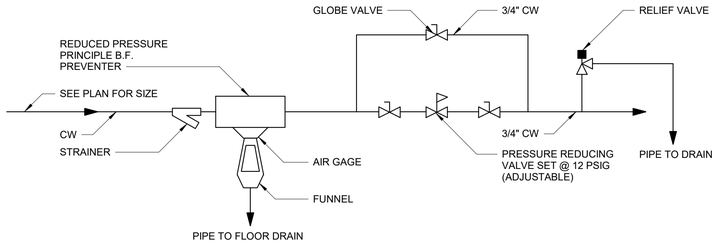
PROCESS	DIMENSIONS (IN)				
	D	A	I	T	L
RAS STATION LINES (1-5)	3"	1"	3/4"	3/4"	SUFFICENT LENGTH SO THAT INJECTION QUILL STINGER END IS NEAR THE CENTER OF THE TEE FLOW CENTER LINE
INFLUENT PRECHLORINATION	3"	1"	3/4"	3/4"	
HEADWORKS	NOTE 4		3/8"	3/8"	
	REFER TO DETAIL M-40-0100				

NOTES:

1. THE RAS STATION UPSTREAM INJECTION SHUT OFF VALVE SHALL BE HOUSED IN THE VALVE CONTAINMENT BOX. BOTH VALVES SHOWN IN THIS DETAIL SHALL BE PVC BALL VALVES.
2. ONLY ONE CHECK VALVE IS REQUIRED. THE CHECK VALVE CAN EITHER BE INTEGRATED INTO THE INJECTION QUILL OR DOWNSTREAM OF THE FIRST BALL VALVE. THE CHECK VALVE BALL AND SPRING SHALL BE CHEMICALLY COMPATIBLE WITH 12.5% TRADE SODIUM HYPOCHLORITE SUCH AS CERAMIC AND TITANIUM RESPECTIVELY.
3. CHEMICAL SUPPLY LINES AT 1/2" OR SMALLER SHALL BE REINFORCED CHEMICALLY RESISTANT TUBING ALL OTHER SIZES SHALL BE SCHEDULE 80 PVC.
4. COORDINATE WITH SEPARATE ODOR CONTROL SCUBBER IMPROVEMENT PROJECT.
5. CHEMICAL INJECTION QUILL SHALL BE INSTALLED IN INTERIOR SPACES OR IN A MANHOLE BUILT AROUND THE PROCESS PIPE. ORIENTATION WILL VARY TO SUIT THE INSTALLATION, TAKING INTO ACCOUNT CHEMICAL CONSIDERATIONS AND REQUIRED CLEARANCE FOR RETRACTION AND INSERTION.
6. ALL WETTED COMPONENTS OF INJECTION QUILL SHALL BE COMPLETELY RESISTANT TO CORROSION BY THE SPECIFIED CHEMICAL.
7. CHEMICAL INJECTION QUILL SHALL BE PROVIDED AS SPECIFIED IN SPECIFICATION SECTION 46 41 42.
8. PIPE SUPPORTS SHALL BE PROVIDED FOR FLEXIBLE CHEMICAL LINE AND RIGID CHEMICAL PIPING UPSTREAM OF THE INJECTION QUILL TO PREVENT FATIGUE AT THE TRANSITION COUPLING. RIGID AND FLEXIBLE CHEMICAL PIPING SHALL NOT BE SUPPORTED BY THE INJECTION QUILL.

ALL PVC INJECTION QUILL DETAIL

DETAIL 2



REDUCED PRESSURE BACKFLOW PREVENTER

P-22-0303

REV	ISSUED FOR	DATE	BY
1	ADDENDUM NO. 3	03/2026	

PROJECT ENGINEER:	J. BOWDAN
DESIGNED BY:	A. QIU
DRAWN BY:	J. COPPOLA
CHECKED BY:	P. COOKE

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE (0, 1/2", 1")

Hazen

HAZEN AND SAWYER
4000 HOLLYWOOD BLVD SUITE 750N
HOLLYWOOD, FL 33021

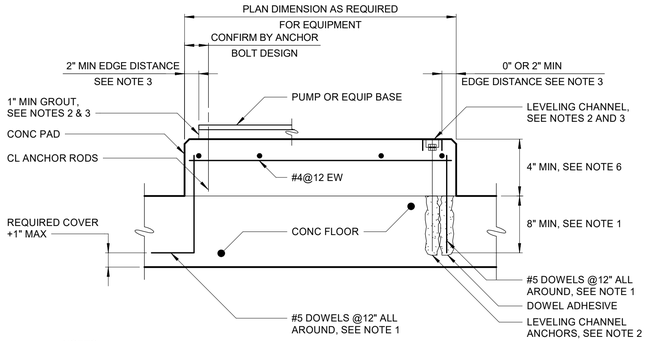
CITY OF HOLLYWOOD
HOLLYWOOD, FLORIDA

SODIUM HYPOCHLORITE
TEMPORARY STORAGE AND FEED SYSTEM

MECHANICAL
TYPICAL DETAILS 2

DATE:	MARCH 2026
PROJECT NO.:	4321-111
CONTRACT NO.:	22-8073
DRAWING NUMBER:	M-17

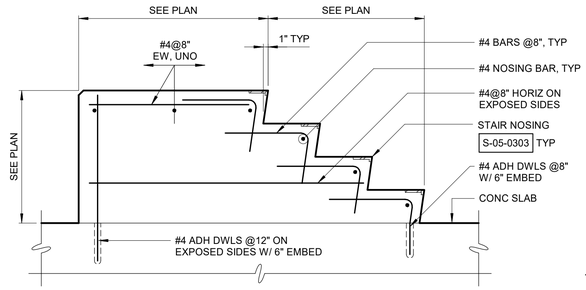
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NOTES:
1. DOWELS MAY BE CAST IN WITH 90° HOOK OR ANCHORED WITH DOWEL ADHESIVE AT CONTRACTORS OPTION. WHERE FLOOR IS LESS THAN 10" THICK, USE #4 DOWELS EMBEDDED TO WITHIN 2" OF BOTTOM OF FLOOR SLAB.
2. THE CONTRACTOR SHALL PROVIDE LEVELING CHANNELS AND LEVELING CHANNEL ANCHORS FOR SWITCHGEAR, SWITCHBOARDS, MOTOR CONTROL CENTERS, AND SIMILAR EQUIPMENT WHEN REQUIRED TO MEET EQUIPMENT MANUFACTURER'S LEVELING TOLERANCES. THE CONTRACTOR SHALL PROVIDE 1" MINIMUM GROUT FOR PUMPS AND SIMILAR EQUIPMENT WHEN REQUIRED TO MEET EQUIPMENT MANUFACTURER'S UNIFORM BEARING AND LEVELING REQUIREMENTS. GROUT BELOW BASE PLATE SHALL BE AS STIPULATED IN SPECIFICATION 03 60 00, UNLESS OTHERWISE RECOMMENDED BY MANUFACTURER OF EQUIPMENT.
3. PRIOR TO PLACING CONCRETE PAD, LEVELING CHANNEL SIZE AND MEANS OF INSTALLATION, ANCHORAGE, GROUT, CONCRETE EDGE DISTANCE, AND CONCRETE BLOCKOUTS REQUIREMENTS SHALL BE COORDINATED WITH EQUIPMENT MANUFACTURER.
4. COAT DISSIMILAR MATERIALS PER THE CONTRACT DOCUMENTS.
5. STAGGER CHANNEL ANCHORS AND PAD DOWELS.
6. FOR PADS 24" OR GREATER IN DEPTH, PROVIDE #4@8" HORIZONTAL SKIN REINFORCING AROUND PERIMETER OF PAD.

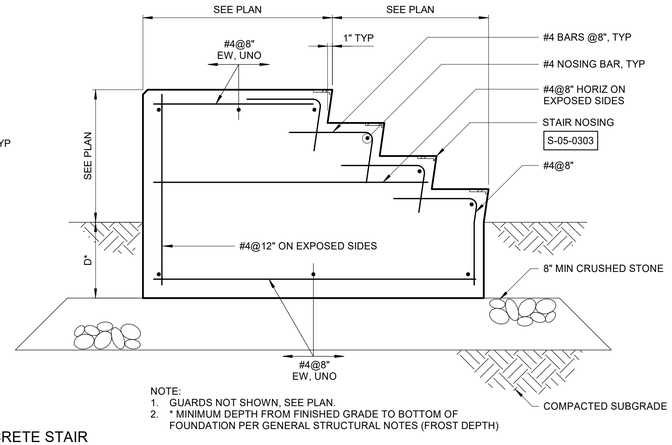
EQUIPMENT PAD

S-03-0504



NOTE: GUARDS NOT SHOWN, SEE PLAN.

MASS CONCRETE STAIR ON SLAB

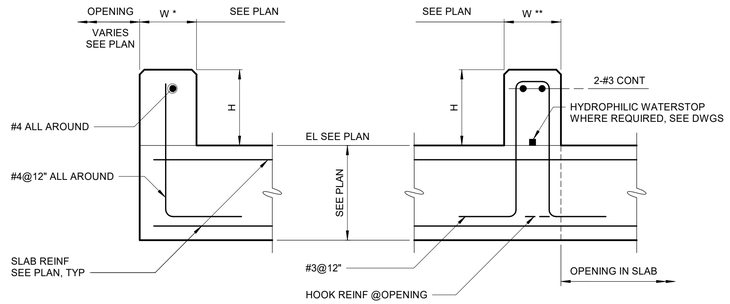


NOTE:
1. GUARDS NOT SHOWN, SEE PLAN.
2. * MINIMUM DEPTH FROM FINISHED GRADE TO BOTTOM OF FOUNDATION PER GENERAL STRUCTURAL NOTES (FROST DEPTH)

MASS CONCRETE STAIR

S-03-0605

ISOLATED MASS CONCRETE STAIR



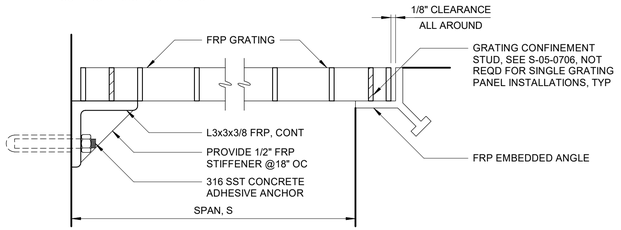
NOTE:
1. W* DENOTES CURBS LESS THAN 8"
2. W** DENOTES CURBS EQUAL TO OR GREATER THAN 8".
3. DOWELS INTO BEAMS SHALL BE CAST IN UNLESS APPROVED BY ENGINEER. ALL OTHER DOWELS MAY BE CAST IN OR ANCHORED WITH DOWEL ADHESIVE SYSTEM WITH A 6" MINIMUM EMBEDMENT.
4. WHERE FLOOR IS 8" THICK OR LESS, USE DOWELS EMBEDDED TO WITHIN 2" OF BOTTOM OF FLOOR SLAB.

CONCRETE CURB

S-03-0603

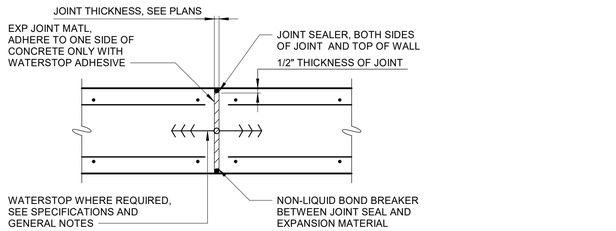
SPAN, S	DEPTH (MIN)	CONCRETE ANCHOR (SIZE AND SPACING)
0'-0" < S ≤ 3'-6"	1 1/2"	1/2"∅x5 1/2" @ 18"
3'-6"< S ≤ 5'-0"	2"	5/8"∅x6" @ 18"

SCHEDULE BASED ON 150 PSF



FRP GRATING

S-06-0101



EXPANSION JOINT

S-03-0201

REV	ISSUED FOR	DATE	BY
1	ADDENDUM No. 3	03/2025	JPS

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE (0 1/2" 1")

PROJECT ENGINEER:	J. BOWDEN
DESIGNED BY:	J. SILVA
DRAWN BY:	E. McCLELLAN
CHECKED BY:	J. SILVA

Hazen
HAZEN AND SAWYER
4000 HOLLYWOOD BLVD SUITE 750N
HOLLYWOOD, FL 33021

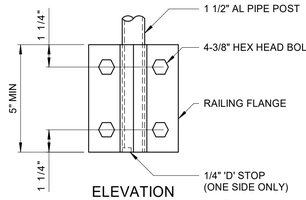
CITY OF HOLLYWOOD
HOLLYWOOD, FLORIDA

SODIUM HYPOCHLORITE
TEMPORARY STORAGE AND FEED SYSTEM

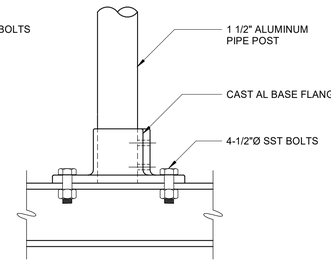
STRUCTURAL
TYPICAL DETAILS
SHEET 1

DATE:	DECEMBER 2025
PROJECT NO.:	4321-111
CONTRACT NO.:	22-8073
DRAWING NUMBER:	1 S-09

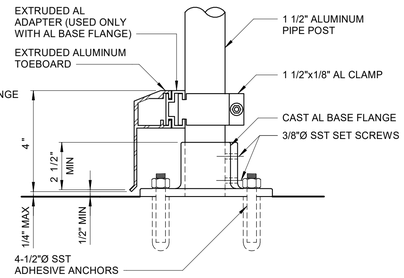
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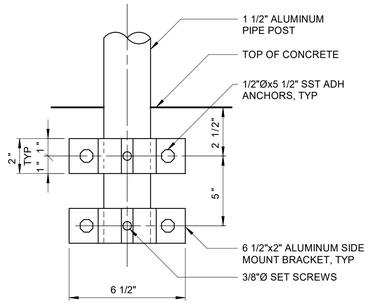
SIDE MOUNT
TO METAL



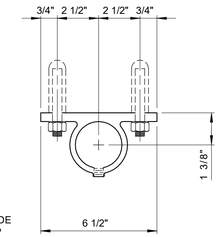
SURFACE MOUNTED
TO METAL



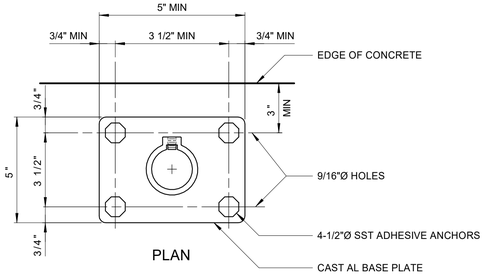
SURFACE MOUNTED
TO CONCRETE



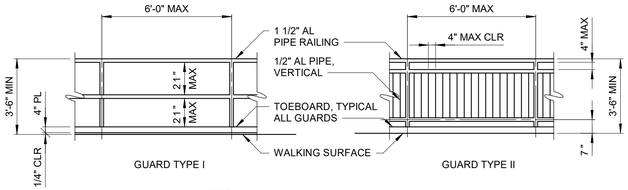
SIDE MOUNT
TO CONCRETE



PLAN

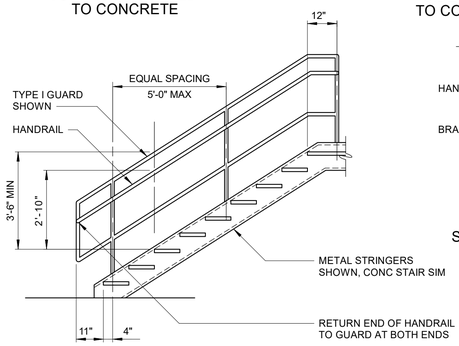


PLAN

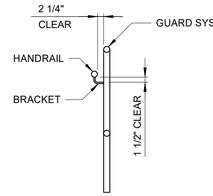


NOTE:
UNLESS SHOWN OTHERWISE ON THE
CONTRACT DRAWING, GUARDS SHALL BE TYPE I.

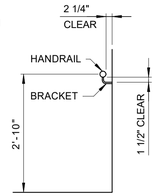
ELEVATION



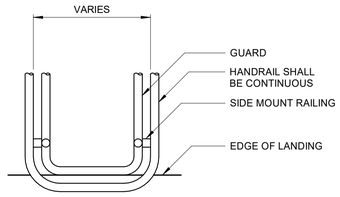
ALUMINUM GUARDS AND HANDRAILS



STAIR GUARD SECTION



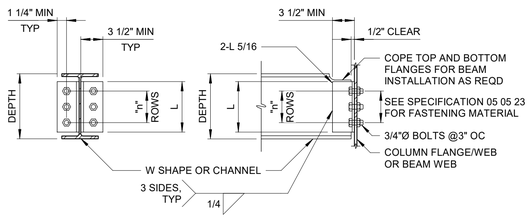
WALL HANDRAIL



TYPICAL STAIR
HANDRAIL TURN

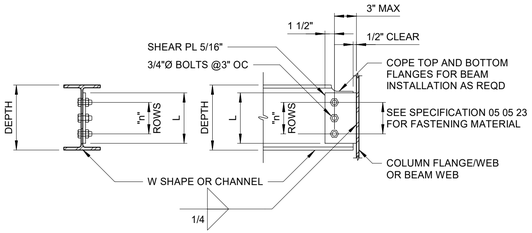
NOTE:
DESIGN OF GUARDS AND HANDRAIL SYSTEMS IS EXCLUSIVELY THE RESPONSIBILITY OF THE CONTRACTOR. DETAILS SHOWN ARE MINIMUM REQUIREMENTS FOR MEMBERS AND CONNECTIONS. CONTRACTOR SHALL PROVIDE AND SUBMIT DRAWINGS AND STRUCTURAL CALCULATIONS, BOTH SEALED BY A PROFESSIONAL ENGINEER CURRENTLY REGISTERED IN THE STATE OR COMMONWEALTH WHERE THE PROJECT IS LOCATED.

S-05-0601



TYPE I DOUBLE ANGLE

NOMINAL BEAM DEPTH	(n) ROWS	L
8"-10"	2	5 1/2"
12"-15"	3	8 1/2"
16"-18"	4	11 1/2"
21"	5	1'-2 1/2"
24"	6	1'-5 1/2"
27"	7	1'-8 1/2"
30"	8	1'-11 1/2"
33"	9	2'-2 1/2"
36"	10	2'-5 1/2"



TYPE II SINGLE PLATE

NOTE:
TYPE I DOUBLE ANGLE CONNECTION
SHALL BE USED UNO ON DRAWINGS.

W SHAPE LOWER BOUND CAPACITY (KIPS) SEE NOTES TO ENGINEER			
DOUBLE ANGLE		SINGLE PLATE	
ASD	LRFD	ASD	LRFD
12.4	18.7	12.4	18.7
23.0	34.4	23.0	34.4
39.0	58.5	39.0	58.5
69.0	103.6	54.1	81.3
94.4	141.4	59.3	89.1
128.8	193.2	72.1	108.0
151.3	227.0	84.7	127.0
185.0	278.0	94.8	142.0
205.0	308.0	105.0	157.0

NOTE : CHART NOT
APPLICABLE TO CHANNELS

STEEL FRAMING CONNECTION

S-05-0102

REV	ISSUED FOR	DATE	BY
1	ADDENDUM No. 3	03/2025	JPS

PROJECT ENGINEER:	J. BOWDEN
DESIGNED BY:	J. SILVA
DRAWN BY:	E. McCLELLAN
CHECKED BY:	J. SILVA

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE 0 1/2" 1"

Hazen
HAZEN AND SAWYER
4000 HOLLYWOOD BLVD SUITE 750N
HOLLYWOOD, FL 33021

CITY OF HOLLYWOOD
HOLLYWOOD, FLORIDA

SODIUM HYPOCHLORITE
TEMPORARY STORAGE AND FEED SYSTEM

STRUCTURAL
TYPICAL DETAILS
SHEET 2

DATE:	DECEMBER 2025
PROJECT NO.:	4321-111
CONTRACT NO.:	22-8073
DRAWING NUMBER:	S-10

Autodesk Docs://04321-111/04321-111-General-Stru.rvt
3/3/2026 11:22:08 AM

NaCLO. BULK STORAGE TANK No. 2 (TK-65412) NaCLO. BULK STORAGE TANK No. 4 (TK-65414) NaCLO. BULK STORAGE TANK No. 6 (TK-65416)

NaCLO. BULK STORAGE TANK No. 1 (TK-65411) NaCLO. BULK STORAGE TANK No. 3 (TK-65413) NaCLO. BULK STORAGE TANK No. 5 (TK-65415)

HMI (SCADA)

RIO-5 (PLC-4)

LEVEL ALARM HIGH HIGH LAHH 65410 A

LEVEL ALARM HIGH HIGH LAHH 65410 B

VOLUME LQI 65412

LOW LEVEL ALARM LAL 65412

LEVEL LI 65412

MAX FILL LVL ALM LAH 65412

HH LVL ALM LAHH 65412

VOLUME LQI 65414

LOW LEVEL ALARM LAL 65414

LEVEL LI 65414

MAX FILL LVL ALM LAH 65414

HH LVL ALM LAHH 65414

VOLUME LQI 65416

LOW LEVEL ALARM LAL 65416

LEVEL LI 65416

MAX FILL LVL ALM LAH 65416

HH LVL ALM LAHH 65416

VOLUME LQI 65411

LOW LEVEL ALARM LAL 65411

LEVEL LI 65411

MAX FILL LVL ALM LAH 65411

HH LVL ALM LAHH 65411

VOLUME LQI 65413

LOW LEVEL ALARM LAL 65413

LEVEL LI 65413

MAX FILL LVL ALM LAH 65413

HH LVL ALM LAHH 65413

VOLUME LQI 65415

LOW LEVEL ALARM LAL 65415

LEVEL LI 65415

MAX FILL LVL ALM LAH 65415

HH LVL ALM LAHH 65415

1 UIC 65412

1 UIC 65414

1 UIC 65416

1 UIC 65411

1 UIC 65413

1 UIC 65415

FUNCTIONAL CONTROL DESCRIPTION NOTES:

1 PROVIDE VOLUMETRIC CALCULATION AND DIGITAL ALARMS BASED ON LEVEL TRANSMITTER MEASUREMENTS. THE SETPOINT FOR THE HIGH-HIGH LEVEL ALARM SHALL BE CONFIGURED ABOVE THE MAXIMUM FILL LEVEL SETPOINT.

NOTES:

1. ALL BALL VALVES FOR SODIUM HYPOCHLORITE SERVICE SHALL BE VENTED TYPE CPVC BALL VALVES. REFER TO VALVE SCHEDULE IN MECHANICAL SPECIFICATIONS FOR MORE INFORMATION.
2. SEE NON-CONTACT RADAR INSTALLATION DETAIL ON I-10.

ES 120/1

BULK STORAGE TANK No. 2 — LEVEL LI 65412; MAX FILL LEVEL LAH 65412; HH LVL ALARM LAHH 65412

BULK STORAGE TANK No. 4 — LEVEL LI 65414; MAX FILL LEVEL LAH 65414; HH LVL ALARM LAHH 65414

BULK STORAGE TANK No. 6 — LEVEL LI 65416; MAX FILL LEVEL LAH 65416; HH LVL ALARM LAHH 65416

RESET/ HORN SILENCE HMS 65422

WEST SODIUM HYPOCHLORITE UNLOADING LOCAL ALARM PANEL LAP–65422

ES 120/1

BULK STORAGE TANK No. 1 — LEVEL LI 65411; MAX FILL LEVEL LAH 65411; HH LVL ALARM LAHH 65411

BULK STORAGE TANK No. 3 — LEVEL LI 65413; MAX FILL LEVEL LAH 65413; HH LVL ALARM LAHH 65413

BULK STORAGE TANK No. 5 — LEVEL LI 65415; MAX FILL LEVEL LAH 65415; HH LVL ALARM LAHH 65415

RESET/ HORN SILENCE HMS 65421

EAST SODIUM HYPOCHLORITE UNLOADING LOCAL ALARM PANEL LAP–65421

TYP. UNLOADING ALARM PANEL. CONSTRUCTION PER DETAIL ON I-10

2" QUICK CONNECT WITH KEY LOCK DUST CAP (TYP.)

2" SH

D D D D D D D D

NOTE 2 (TYP.)

LT 65411

LT 65413

LT 65415

LT 65412

LT 65414

LT 65416

V

REVERSE FLOAT LEVEL GAUGE. (TYP.)

PAINTED STEEL PIPE SUPPORT DESIGNED BY CONTRACTOR. (TYP.)

SODIUM HYPOCHLORITE BULK STORAGE TANK No. 1 6650 GAL — TK-65411 — LG 65411

SODIUM HYPOCHLORITE BULK STORAGE TANK No. 3 6650 GAL — TK-65413 — LG 65413

SODIUM HYPOCHLORITE BULK STORAGE TANK No. 5 6650 GAL — TK-65415 — LG 65415

SODIUM HYPOCHLORITE BULK STORAGE TANK No. 2 6650 GAL — TK-65412 — LG 65412

SODIUM HYPOCHLORITE BULK STORAGE TANK No. 4 6650 GAL — TK-65414 — LG 65414

SODIUM HYPOCHLORITE BULK STORAGE TANK No. 6 6650 GAL — TK-65416 — LG 65416

2" SH

3" SH

4" SH

SH I-07

FROM TP-56001

TO TP-56001

ES 120/1

RESET/ HORN SILENCE HMS 65410

HIGH LEVEL ALARM LAH 65410 A

HIGH LEVEL ALARM LAH 65410 B

SODIUM HYPOCHLORITE CONTAINMENT ALARM PANEL CAP–65410

SLIDING TYPE LEVEL SWITCH (TYP.)

CONTAINMENT PUMP OUT

LSH 65410 A

LSH 65410 B

STORAGE TANK CONTAINMENT AREA

2" x 1" — 1" SH — SH I-07 — TO RAS PUMP STATIONS

1" x 1/2" — 1/2" SH — SH I-04 — TO CHLORINE CONTACT BASINS REUSE SYSTEM

1" x 1/2" — 1/2" SH — SH I-04 — TO REUSE SYSTEM PRE-CHLORINATION

1" x 1/2" — 1/2" SH — SH I-05 — TO CHLORINE CONTACT BASINS NON-POT SYSTEM

1" x 1/2" — 1/2" SH — SH I-05 — TO NON-POT SYSTEM PRE-CHLORINATION

1" x 3/4" — 3/4" SH — SH I-06 — TO HEADWORKS ODOR CONTROL SYSTEM

2" x 1 1/2" — 1-1/2" SH — SH I-06 — TO OUTFALL PUMP STATION

2" x 1" — 1" SH — SH I-07 — TO INFLUENT PUMP STATION

TO METERING PUMP SKIDS

REV	ISSUED FOR	DATE	BY
1	ADDENDUM NO. 3	03/2026	

PROJECT ENGINEER: J. BOWDAN

DESIGNED BY: AJM

DRAWN BY: AJM

CHECKED BY: EPC

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE 0 1/2" 1"

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HAZEN AND SAWYER
4000 HOLLYWOOD BLVD SUITE 750N
HOLLYWOOD, FL 33021

CITY OF HOLLYWOOD
HOLLYWOOD, FLORIDA

SODIUM HYPOCHLORITE
TEMPORARY STORAGE AND FEED SYSTEM

INSTRUMENTATION
SODIUM HYPOCHLORITE
BULK STORAGE TANKS P&ID

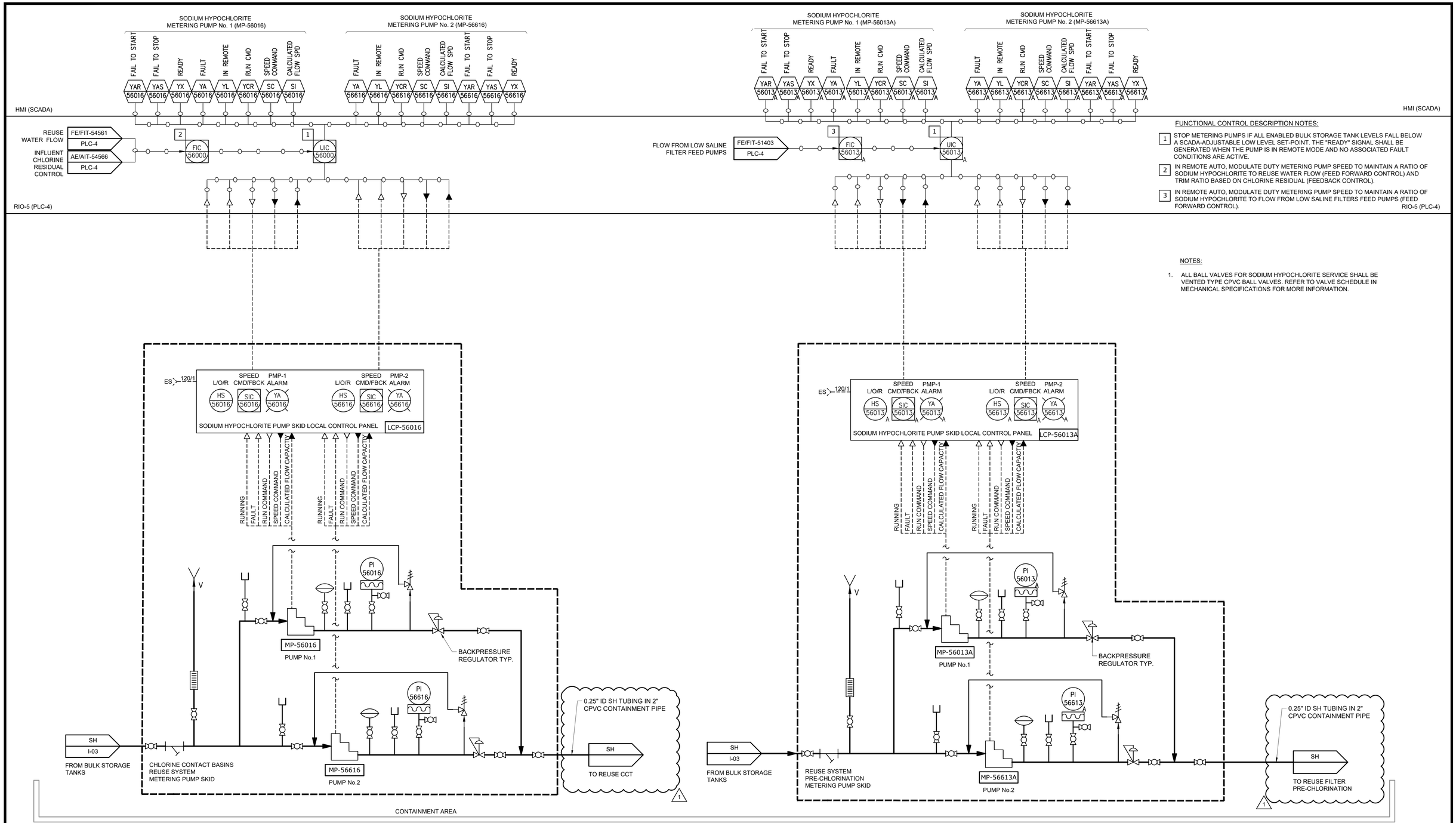
DATE: MARCH 2026

HAZEN NO.: 4321-111

CONTRACT NO.: 22-8073

DRAWING NUMBER: I-03

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PROJECT ENGINEER:	J. BOWDAN
DESIGNED BY:	AJM
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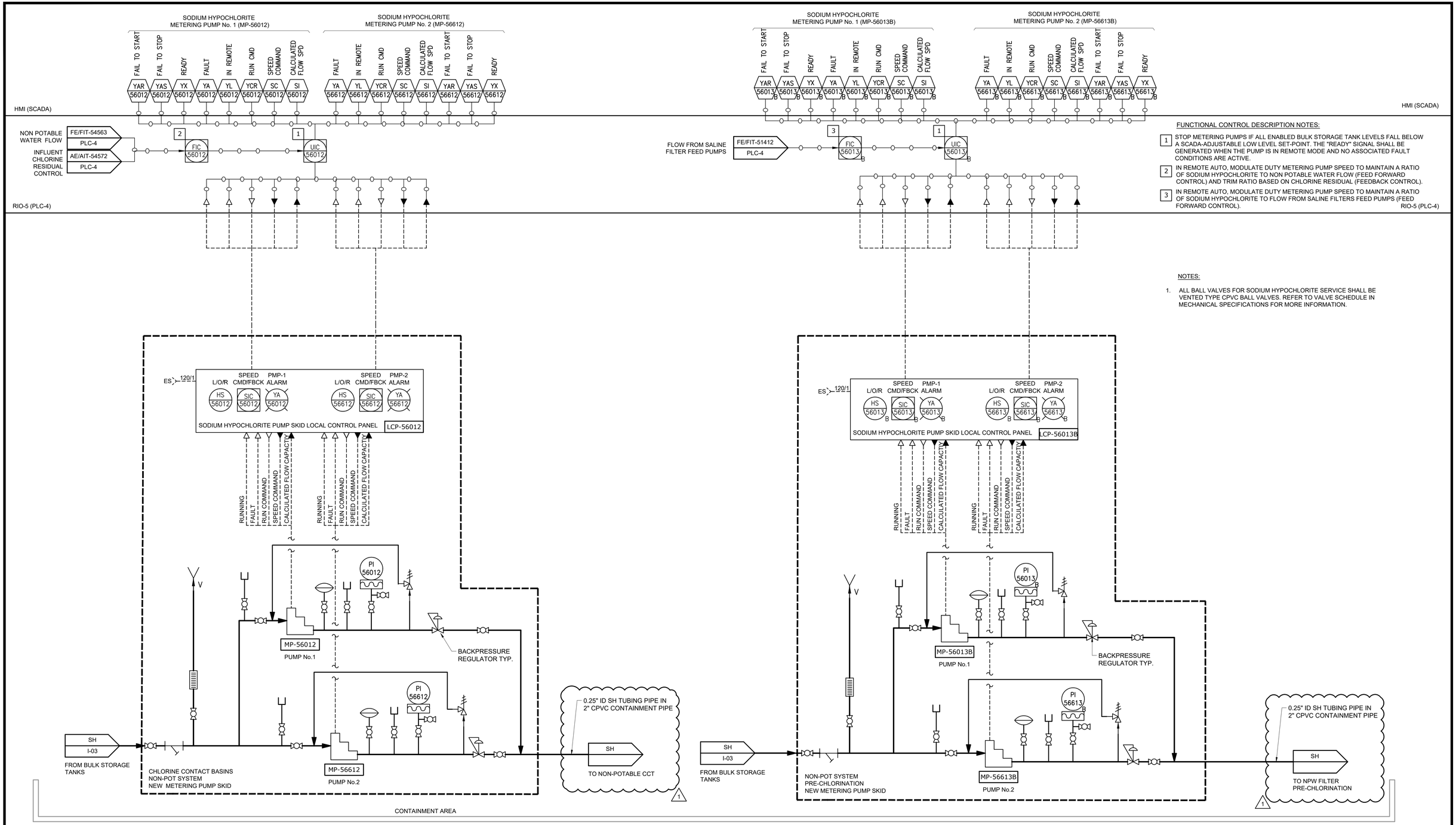
CITY OF HOLLYWOOD
HOLLYWOOD, FLORIDA

SODIUM HYPOCHLORITE
TEMPORARY STORAGE AND FEED SYSTEM

INSTRUMENTATION
SODIUM HYPOCHLORITE FEED SYSTEM
P&ID - SHEET 1

DATE:	MARCH 2026
HAZEN NO.:	4321-111
CONTRACT NO.:	22-8073
DRAWING NUMBER:	I-04

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PROJECT ENGINEER:	J. BOWDAN
DESIGNED BY:	AJM
DRAWN BY:	AJM
CHECKED BY:	EPC

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HAZEN AND SAWYER
4000 HOLLYWOOD BLVD SUITE 750N
HOLLYWOOD, FL 33021

CITY OF HOLLYWOOD
HOLLYWOOD, FLORIDA

SODIUM HYPOCHLORITE
TEMPORARY STORAGE AND FEED SYSTEM

INSTRUMENTATION
SODIUM HYPOCHLORITE FEED SYSTEM
P&ID - SHEET 2

DATE:	MARCH 2026
HAZEN NO.:	4321-111
CONTRACT NO.:	22-8073
DRAWING NUMBER:	I-05

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SODIUM HYPOCHLORITE METERING PUMP No. 1 (MP-56010)

FAIL TO START YAR 56010
FAIL TO STOP YAS 56010
READY YX 56010
FAULT YA 56010
IN REMOTE YL 56010
RUN CMD YCR 56010
SPEED COMMAND SC 56010
CALCULATED FLOW SPD SI 56010

SODIUM HYPOCHLORITE METERING PUMP No. 2 (MP-56610)

FAULT YA 56610
IN REMOTE YL 56610
RUN CMD YCR 56610
SPEED COMMAND SC 56610
CALCULATED FLOW SPD SI 56610
FAIL TO START YAR 56610
FAIL TO STOP YAS 56610
READY YX 56610

HMI (SCADA)

1 UIC 56010

RIO-5 (PLC-4)

SODIUM HYPOCHLORITE METERING PUMP No. 1 (MP-56015)

FAIL TO START YAR 56015
FAIL TO STOP YAS 56015
READY YX 56015
FAULT YA 56015
IN REMOTE YL 56015
RUN CMD YCR 56015
SPEED COMMAND SC 56015
CALCULATED FLOW SPD SI 56015

SODIUM HYPOCHLORITE METERING PUMP No. 2 (MP-56615)

FAULT YA 56615
IN REMOTE YL 56615
RUN CMD YCR 56615
SPEED COMMAND SC 56615
CALCULATED FLOW SPD SI 56615
FAIL TO START YAR 56615
FAIL TO STOP YAS 56615
READY YX 56615

HMI (SCADA)

EFFLUENT FLOW — FE/FIT-56476 — PLC-4
EFFLUENT CHLORINE RESIDUAL — AE/AIT-54995 — PLC-3

2 FIC 56015

1 UIC 56015

RIO-5 (PLC-4)

FUNCTIONAL CONTROL DESCRIPTION NOTES:

1 STOP METERING PUMPS IF ALL ENABLED BULK STORAGE TANK LEVELS FALL BELOW A SCADA-ADJUSTABLE LOW LEVEL SET-POINT. THE "READY" SIGNAL SHALL BE GENERATED WHEN THE PUMP IS IN REMOTE MODE AND NO ASSOCIATED FAULT CONDITIONS ARE ACTIVE.

2 IN REMOTE AUTO, MODULATE DUTY METERING PUMP SPEED TO MAINTAIN A RATIO OF SODIUM HYPOCHLORITE TO EFFLUENT FLOW (FEED FORWARD CONTROL) AND TRIM RATIO BASED ON CHLORINE RESIDUAL (FEEDBACK CONTROL).

NOTES:

1. ALL BALL VALVES FOR SODIUM HYPOCHLORITE SERVICE SHALL BE VENTED TYPE CPVC BALL VALVES. REFER TO VALVE SCHEDULE IN MECHANICAL SPECIFICATIONS FOR MORE INFORMATION.

ES 120/1

SODIUM HYPOCHLORITE PUMP SKID LOCAL CONTROL PANEL — LCP-56010

	L/O/R	SPEED CMD/FBCK	PMP-1 ALARM
	HS 56010	SIC 56010	YA 56010

	L/O/R	SPEED CMD/FBCK	PMP-2 ALARM
	HS 56610	SIC 56610	YA 56610

RUNNING
FAULT
RUN COMMAND
SPEED COMMAND
CALCULATED FLOW CAPACITY

PI 56010
PI 56610

MP-56010 PUMP No.1
MP-56610 PUMP No.2

BACKPRESSURE REGULATOR TYP.

V

SH I-03 FROM BULK STORAGE TANKS

HEADWORKS ODOR CONTROL SYSTEM METERING PUMP SKID

0.5" ID SH TUBING PIPE IN 2" CPVC CONTAINMENT PIPE

SH TO HEADWORKS ODOR CONTROL SYSTEM

1

SH I-03 FROM BULK STORAGE TANKS

ES 120/1

SODIUM HYPOCHLORITE PUMP SKID LOCAL CONTROL PANEL — LCP-56615

	L/O/R	SPEED CMD/FBCK	PMP-1 ALARM
	HS 56015 A	SIC 56015	YA 56015

	L/O/R	SPEED CMD/FBCK	PMP-2 ALARM
	HS 56615 A	SIC 56615	YA 56615

RUNNING
FAULT
RUN COMMAND
SPEED COMMAND
CALCULATED FLOW CAPACITY

PI 56015
PI 56615

MP-56015 PUMP No.1
MP-56615 PUMP No.2

BACKPRESSURE REGULATOR TYP.

V

EFFLUENT PUMP STATION METERING PUMP SKID

1" SH CPVC CARRIER PIPE IN 3" CPVC CONTAINMENT PIPE

SH TO EFFLUENT PUMP STATION

1

CONTAINMENT AREA

REV	ISSUED FOR	DATE	BY
1	ADDENDUM NO. 3	03/2026	

PROJECT ENGINEER: J. BOWDAN
DESIGNED BY: AJM
DRAWN BY: AJM
CHECKED BY: EPC
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE 0 1/2" 1"

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HAZEN AND SAWYER
4000 HOLLYWOOD BLVD SUITE 750N
HOLLYWOOD, FL 33021

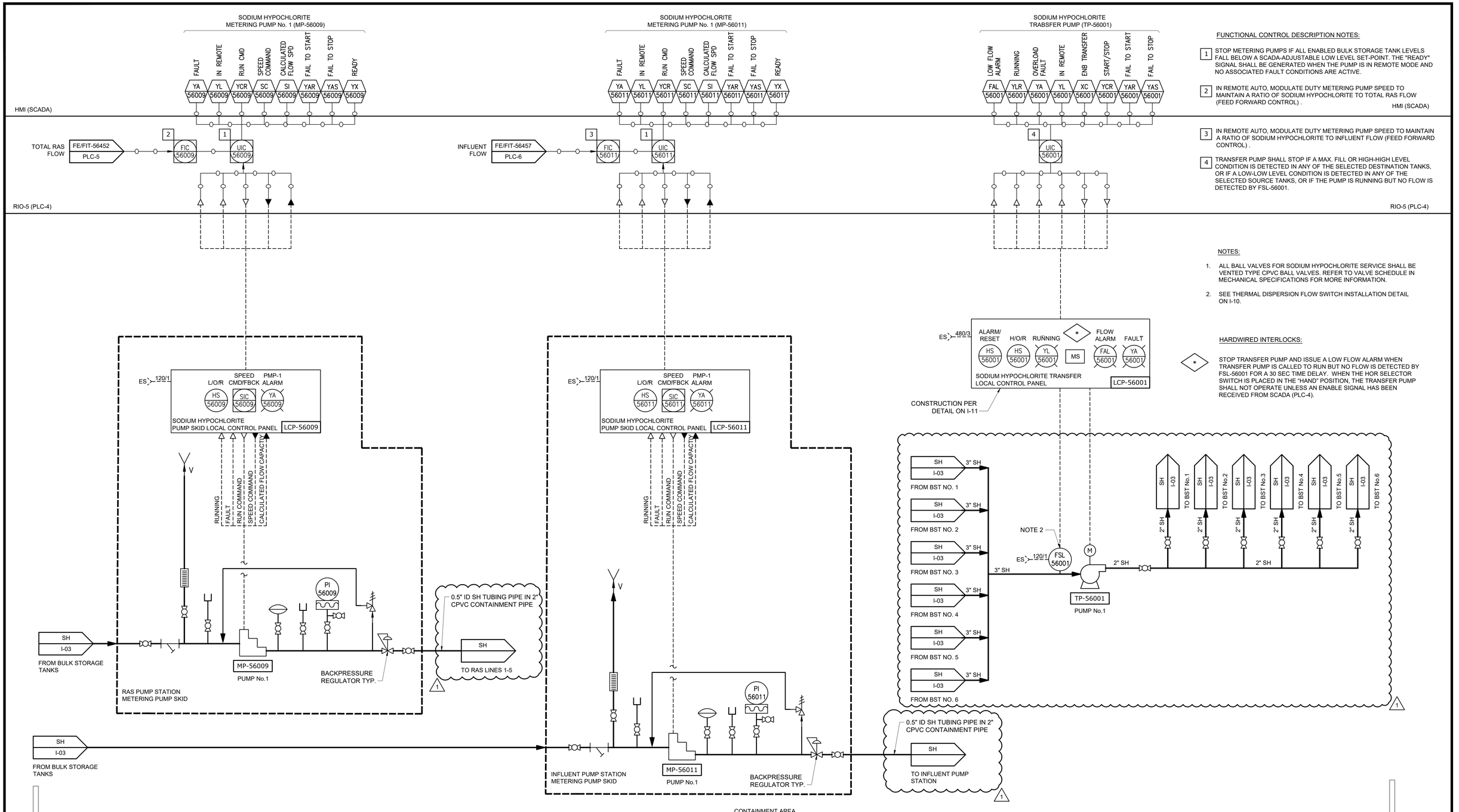
CITY OF HOLLYWOOD
HOLLYWOOD, FLORIDA

SODIUM HYPOCHLORITE
TEMPORARY STORAGE AND FEED SYSTEM

INSTRUMENTATION
SODIUM HYPOCHLORITE FEED SYSTEM
P&ID - SHEET 3

DATE: MARCH 2026
HAZEN NO.: 4321-111
CONTRACT NO.: 22-8073
DRAWING NUMBER: I-06

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PROJECT ENGINEER:	J. BOWDAN
DESIGNED BY:	AJM
DRAWN BY:	AJM
CHECKED BY:	EPC

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE (0, 1/2", 1")

Hazen
HAZEN AND SAWYER
4000 HOLLYWOOD BLVD SUITE 750N
HOLLYWOOD, FL 33021

CITY OF HOLLYWOOD
HOLLYWOOD, FLORIDA

SODIUM HYPOCHLORITE
TEMPORARY STORAGE AND FEED SYSTEM

INSTRUMENTATION
SODIUM HYPOCHLORITE FEED & TRANSFER SYSTEM P&ID

DATE:	MARCH 2026
HAZEN NO.:	4321-111
CONTRACT NO.:	22-8073
DRAWING NUMBER:	I-07

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FLOW ALARM HIGH
FAH 65421
FAH 65422
FAH 65423
FAH 65424
FAH 65425

HMI (SCADA)

RIO-5 (PLC-4)

120/1 ES
FSH 65421
BULK STORAGE AREA
EYEWASH/SHOWER NO. 1
EW-65421

METERING PUMP SKIDS AREA
BULK STORAGE TANKS AREA

FSH 65422
BULK STORAGE AREA
EYEWASH/SHOWER NO. 2
EW-65422

FSH 65423
BULK STORAGE AREA
EYEWASH/SHOWER NO. 3
EW-65423

FSH 65424
BULK STORAGE AREA
EYEWASH/SHOWER NO. 4
EW-65424

FSH 65425
BULK STORAGE AREA
EYEWASH/SHOWER NO. 5
EW-65425

EYEWASH / SHOWERS

1

REV	ISSUED FOR	DATE	BY
1	ADDENDUM NO. 3	03/2026	

PROJECT ENGINEER: J. BOWDAN
DESIGNED BY: AJM
DRAWN BY: AJM
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Hazen
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4000 HOLLYWOOD BLVD SUITE 750N
HOLLYWOOD, FL 33021

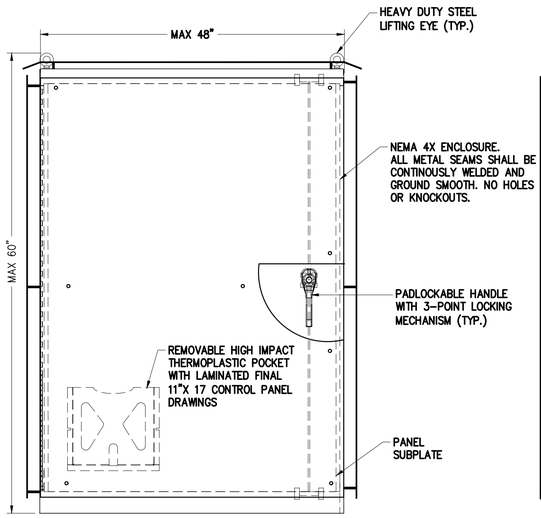
CITY OF HOLLYWOOD
HOLLYWOOD, FLORIDA

SODIUM HYPOCHLORITE
TEMPORARY STORAGE AND FEED SYSTEM

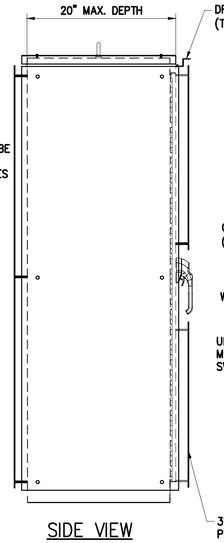
INSTRUMENTATION
MISCELLANEOUS P&ID

DATE: MARCH 2026
HAZEN NO.: 4321-111
CONTRACT NO.: 22-8073
DRAWING NUMBER: I-08

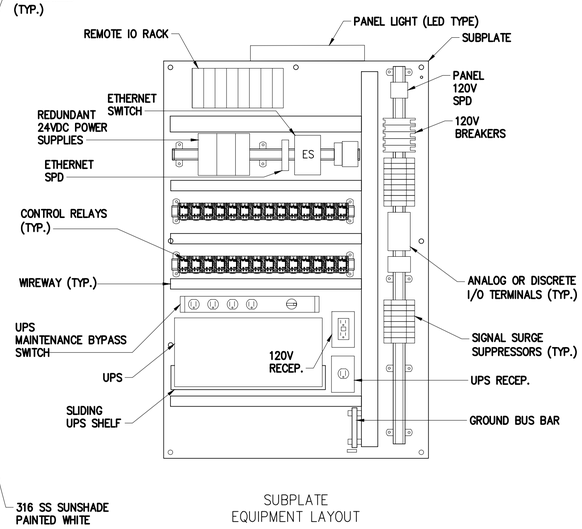
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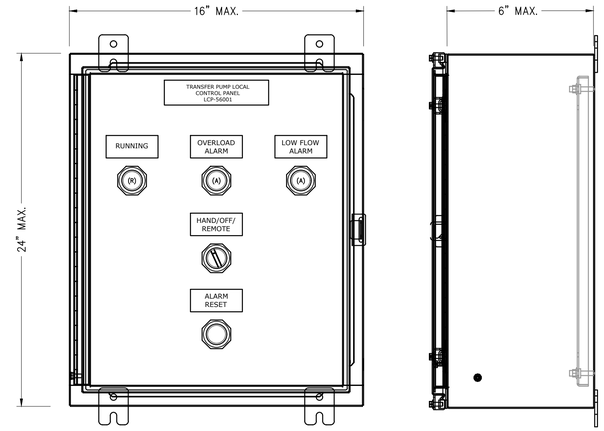
FRONT VIEW
NEMA 4X PAINTED WHITE



SIDE VIEW



SUBPLATE
EQUIPMENT LAYOUT

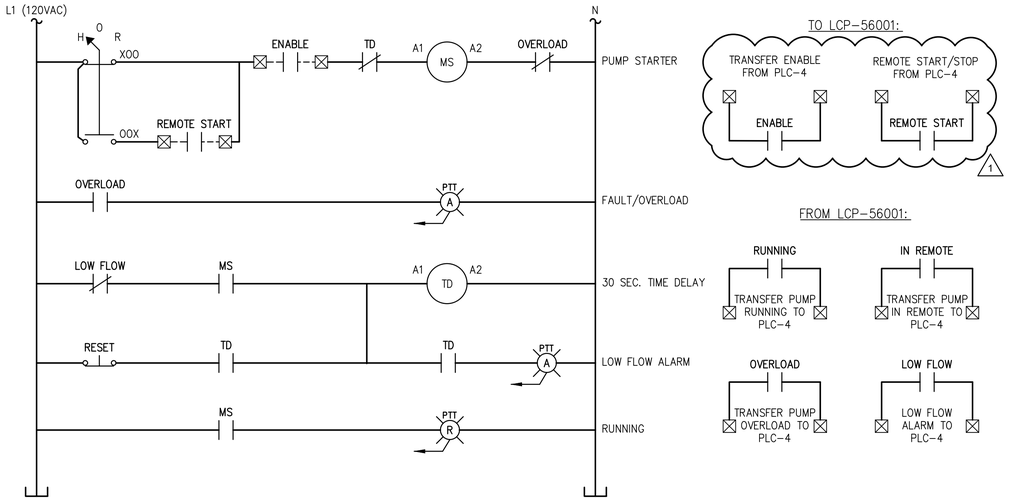


NOTES:

1. ENCLOSURE SHALL MEET ALL REQUIREMENTS OF THE APPLICABLE DIVISION 26 AND DIVISION 40 SPECIFICATIONS.
2. CONTRACTOR SHALL CAREFULLY PLAN AND EXECUTE CONDUIT STUB UP LOCATIONS AND PENETRATIONS IN BOTTOM OF ENCLOSURE. REMOVAL OF ENCLOSURE BOTTOM TO ACCOMMODATE CONDUITS IS NOT ACCEPTABLE.
3. PROVIDE PANEL INTRUSION SWITCH AND WIRE TO PLC INPUT.
4. PROVIDE SWITCH TO TURN PANEL LIGHT ON WHEN PANEL DOOR OPENS.
5. PROVIDE PANEL THERMOSTAT WIRED TO PLC INPUT TO MONITOR PANEL INTERIOR AIR TEMP.

LOCAL CONTROL PANEL (PLC4 RIO RACK 5)

DETAIL	06
NTS	–



TRANSFER PUMP LOCAL CONTROL PANEL (LCP-56001)

DETAIL	07
NTS	–

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DRAWN BY: AJM
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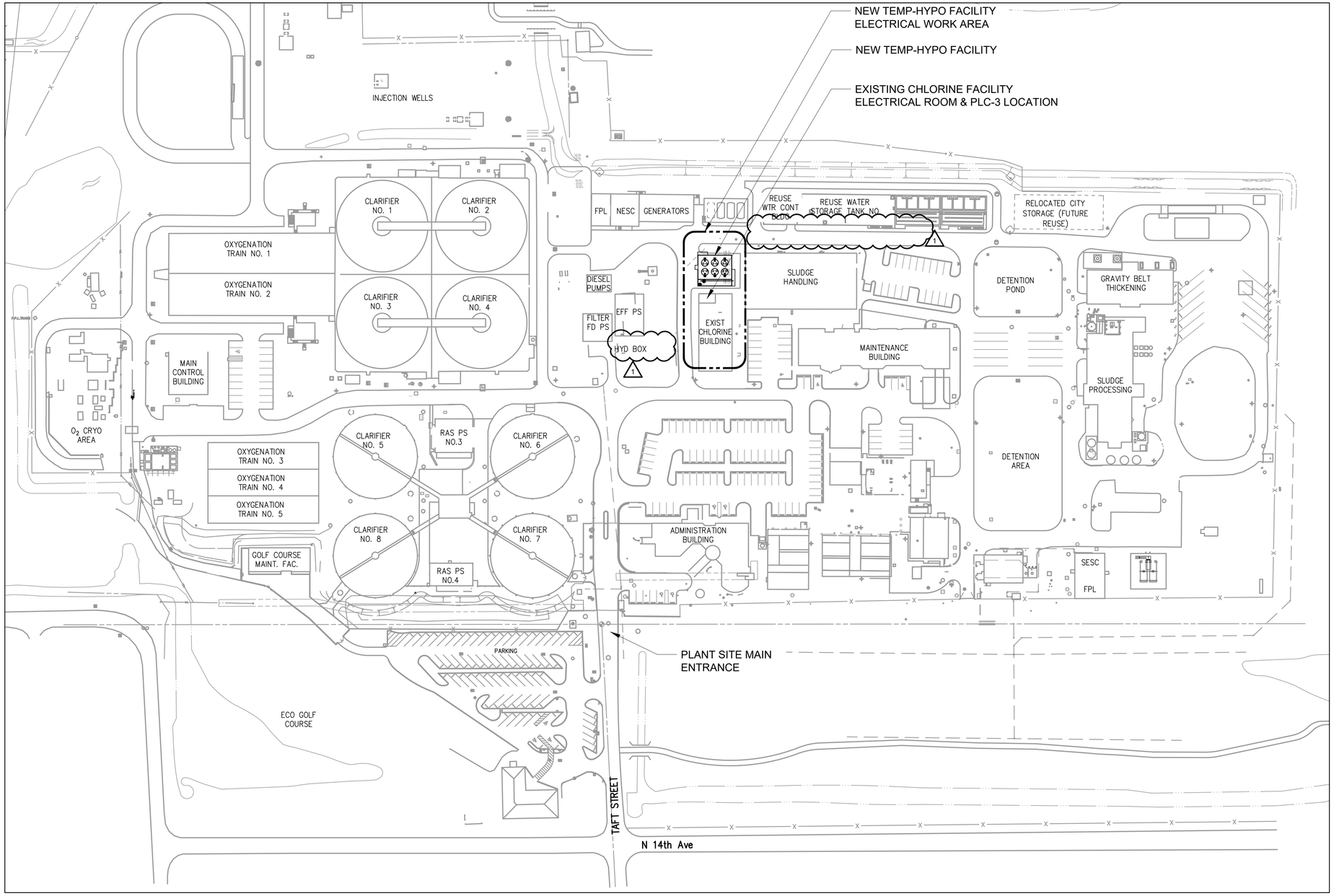
CITY OF HOLLYWOOD
HOLLYWOOD, FLORIDA

SODIUM HYPOCHLORITE
TEMPORARY STORAGE AND FEED SYSTEM

INSTRUMENTATION
TYPICAL DETAILS - SHEET 3

DATE: MARCH 2026
HAZEN NO.: 4321-111
CONTRACT NO.: 22-8073
DRAWING NUMBER: I-11

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1"=80'-0"

80 40 0 80'

REV	ISSUED FOR	DATE	BY
1	ADDENDUM NO. 3	03/2026	JMB

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PROJECT ENGINEER:	J. BOWDAN
DESIGNED BY:	J. BROAD
DRAWN BY:	J. BROAD
CHECKED BY:	J. BURKE

JOHN C. BURKE, PE NO. 17301

Hazen

HAZEN AND SAWYER
4000 HOLLYWOOD BLVD SUITE 750N
HOLLYWOOD, FL 33021

CITY OF HOLLYWOOD
HOLLYWOOD, FLORIDA

SODIUM HYPOCHLORITE
TEMPORARY STORAGE AND FEED SYSTEM

ELECTRICAL
SITE PLAN - OVERALL

DATE:	MARCH 2026
HAZEN NO.:	4321-111
CONTRACT NO.:	22-8073
DRAWING NUMBER:	E-03

File: C:_DOCS\ACCDOCS\HAZEN AND SAWYER\04321-111\PROJECT FILES\1-DESIGN\01-HAZEN\ELEC\04321-111-E03 Saved by JBROAD Save date: 3/9/2026 2:06 PM
PLOT DATE: 3/9/2026 4:24 PM BY: JBROAD

EXISTING GE A SERIES PANELBOARD CHL–"H" IN
EXISTING CHLORINATION FACILITY ELECTRIC ROOM
CAT: AEF3422MBX
MAIN: 225A, 480Y/277, 3–PH, 4–WIRE

NEW 3P–50A

EXISTING CHLORINATION FACILITY

NEW TEMPORARY CHLORINATION FACILITY

3#6, 1#10G, 1"C

60A
3P

NEMA 4X 316 SS

30 kVA XFMR
480–208Y/120V
3P/4W
NEMA 3R DRY TRANS

3#1, 1#8G, 2"C

PANEL LP: TH
208Y/120V, 3PH, 4W
SEE SCHEDULE ON DWG E–08

3P–125A

1P–20A | 1P–20A | 1P–20A | 1P–20A | 1P–20A | 1P–20A

3#12, 1#12G, 3/4"C
2#12, 1#12G, 3/4"C
2#12, 1#12G, 3/4"C
2#12, 1#12G, 3/4"C
3#12, 1#12G, 3/4"C
2#12, 1#12G, 3/4"C

PANEL LP: TH 208Y/120V, 3PH
CONT. ON DWG. E–06

LCP-01003A (PLC-3A)
TEMPORARY HYPO-FACILITY -
MAIN CONTROL PANEL

LCP-01003A (PLC-3A)
CONT. ON DWG E–06

4#16 TSP, 1"C
8#14, 1#14G, 3/4"C

LAP–65422
WEST HYPO TANKS UNLOADING
PANEL

1#16 TSP, 3/4"C

LT 65412 — TK-65412
LT 65414 — TK-65414
LT 65416 — TK-65416

WEST HYPO BULK STORAGE TANKS

4#16 TSP, 1"C
8#14, 1#14G, 3/4"C

LAP–65421
EAST HYPO TANKS UNLOADING
PANEL

1#16 TSP, 3/4"C

LT 65411 — TK-65411
LT 65413 — TK-65413
LT 65415 — TK-65415

EAST HYPO BULK STORAGE TANKS

4#14, 1#14G, 3/4"C

CAP–65410
CONTAINMENT
ALARM PANEL

2#14, 1#14G, 3/4"C
2#14, 1#14G, 3/4"C

LSH 65410 A
LSH 65410 B

CONTAINMENT
FLOOD

14#14, 1#14G, 3/4"C

LCP–56001 HYPO
TRANSFER PUMP
PANEL SEE
I–DWGS

2#14, 1#14G, 1"C
S
120V
3#12, 1#12G, 3/4"C
FSL 56001
M

TP-56001
HYPO TRANSFER
PUMP (2 HP)

10#14, 1#14G, 3/4"C

FSH 65421 | FSH 65422 | FSH 65423 | FSH 65424 | FSH 65425

EYEWASH SHOWERS
ALARMS

1

REV	ISSUED FOR	DATE	BY
1	ADDENDUM NO. 3	03/2026	JMB

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE — 0 1/2" 1"

PROJECT ENGINEER:	J. BOWDAN
DESIGNED BY:	J. BROAD
DRAWN BY:	J. BROAD
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HOLLYWOOD, FL 33021

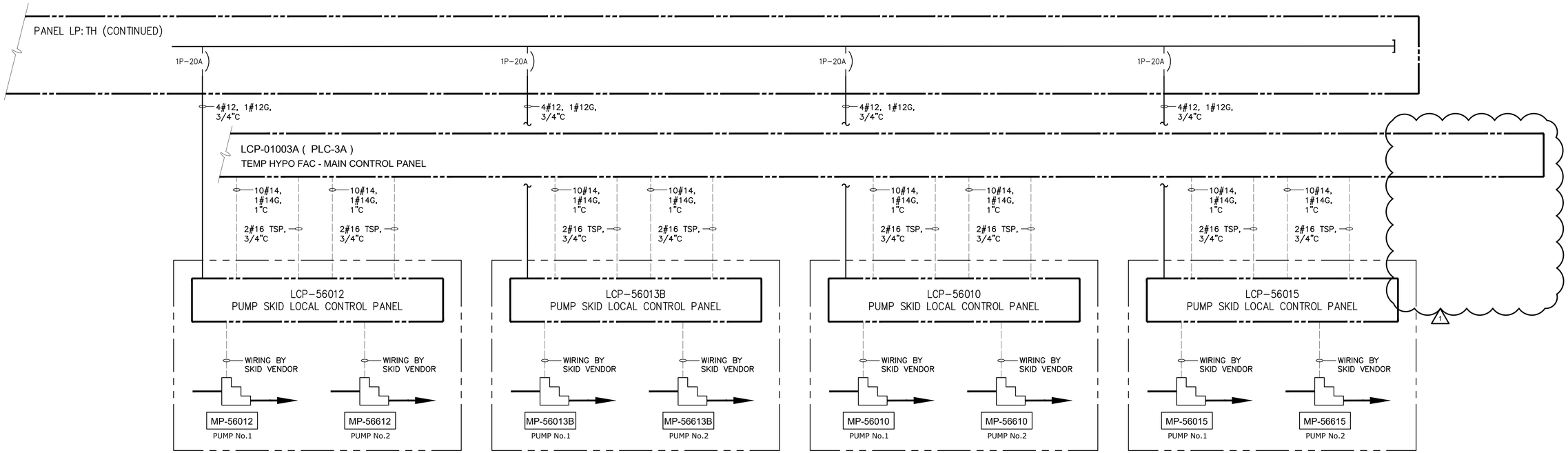
CITY OF HOLLYWOOD
HOLLYWOOD, FLORIDA

SODIUM HYPOCHLORITE
TEMPORARY STORAGE AND FEED SYSTEM

ELECTRICAL
POWER AND CONTROL RISER DIAGRAM
SHEET 1

DATE:	MARCH 2026
HAZEN NO.:	4321-111
CONTRACT NO.:	22-8073
DRAWING NUMBER:	E-05

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CHLORING CONTACT BASIN
NON-POT SYSTEM
METERING PUMP SKID

NON-POT SYSTEM
PRE-CHLORINATION
METERING PUMP SKID

HEADWORKS
ODOR CONTROL SYSTEM
METERING PUMP SKID

EFFLUENT PUMP STATION
METERING PUMP SKID

REV	ISSUED FOR	DATE	BY
1	ADDENDUM NO. 3	03/2026	JMB

PROJECT ENGINEER: J. BOWDAN
DESIGNED BY: J. BROAD
DRAWN BY: J. BROAD
CHECKED BY: J. BURKE

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE 0 1/2" 1"

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HOLLYWOOD, FL 33021

CITY OF HOLLYWOOD
HOLLYWOOD, FLORIDA

SODIUM HYPOCHLORITE
TEMPORARY STORAGE AND FEED SYSTEM

ELECTRICAL
POWER AND CONTROL RISER DIAGRAM
SHEET 3

DATE: MARCH 2026
HAZEN NO.: 4321-111
CONTRACT NO.: 22-8073
DRAWING NUMBER: E-07

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APPENDIX A – GEOTECHNICAL REPORT

SECTION 01 11 00
SUMMARY OF WORK

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes:

1. Summary
2. Location and Description of Work
3. Construction Contracts, This Project
4. Construction Contracts, Other Projects
5. Work by Others
6. Work by Owner
7. Owner Furnished Equipment and Materials
8. Owner Assigned Procurement Contracts
9. Sequence and Progress of Work
10. Contractor's Use of Site
11. Easements and Rights-of-Way
12. Notices to Owners and Authorities of Properties Adjacent to the Work
13. Salvage of Equipment and Materials
14. Partial Utilization by Owner

1.02 LOCATION AND DESCRIPTION OF WORK

A. The Work is located at the following Site:

1. The Southern Regional Wastewater Treatment Plant (SRWWTP), specifically located on the parking lot immediately east of the existing Chlorine Building. Address: 1621 N 14th Ave, Hollywood, FL 33020

11-18-20

B. The Work to be performed under this Contract includes, but is not limited to, constructing the Work described below and all appurtenances related to the Work as described below.

1. New Temporary Sodium Hypochlorite System:

a. Constructed new above ground concrete structure with raised containment curbing, foundation system, access stairs, handrail, and metal canopy system that will support and house new sodium hypochlorite equipment.

b. Furnish and install eight (8) packaged metering pump skids complete with piping, valves, simplex or duplex control panel, and related appurtenances pre-installed on each skid.

c. Furnish and install one (1) transfer pump and associated starter panel, valves, and piping to bulk storage tanks.

d. Furnish and install six (6) 6,650-gallon, dual-walled bulk sodium hypochlorite storage tanks complete with ladders, safety climb system, nozzles and related appurtenances.

e. Furnish and install associated piping, valves, pipe hangers, and supports between tanks, metering pumps, and dosing locations.

f. Furnish and install new electrical gear, panels, conduit, wiring, interior and exterior lighting, outlets, switches and related appurtenances.

g. Furnish and install new instrumentation and controls including PLC-based control panel, tank fill and level monitoring panels, sump high level panel, field devices, and related appurtenances

h. Furnish and install new double containment piping above and below ground from the metering pumps at the New Temporary Sodium Hypochlorite structure to **the following** dosing locations~~.~~**:**

1) Reuse CCT

2) Non-Potable CCT

3) Prechlorination Filters

4) Headworks Odor Control

i. Furnish and install new double containment piping above ground from the metering pumps at the New Temporary Sodium Hypochlorite structure to the following existing chlorine solution injection locations:

1) 1,2,3,4, and 5 RAS

2) Influent Pump Station

~~h.~~ **Modify the existing Motive Water System at the Chlorine Building to eliminate use of the Non-Potable Water supply to the 1,2,3,4, and 5 RAS and Influent Pump Station chlorine solution lines. The existing Motive Water System will only utilize the Potable Water supply.**

~~i. Furnish and install new tapping sleeves, valves, and pipelines from existing NPW loop to new Sodium Hypochlorite Dosing Stations~~

~~j. Furnish and install two (2) new Sodium Hypochlorite Dosing Stations complete with concrete containment pads, panel backboard, motive water piping, injection system, valves, and related appurtenances:~~

~~k. One (1) located near parking lot adjacent to and west of the existing Reuse and Non-Potable Chlorine Contact Tanks.~~

~~l. One (1) located on west wall of the Filter Feed Pump Station adjacent to and north of the Hydraulic Structure.~~

~~m.~~**j.** Perform miscellaneous abandonment in place, removals, and/or relocations of existing plant piping where shown on the drawings.

~~n.~~**k.** Perform pavement demolition and removals. Install new pavement, curbing, and sidewalk where shown on the Drawings and as needed to accommodate the Work and to repair paving and site work damaged by Contractor's operations.

1.03 CONSTRUCTION CONTRACTS, THIS PROJECT

A. The term "Contract Documents" refers to the entire set of Bid Proposal, Agreement, General Conditions, Supplementary Conditions, Technical Specifications and Drawings issued at the time of the bid along with any modifications of the bid documents by way of official addendum issued prior to bid opening.

B. The Drawings included in the Contract Documents are entitled "City of Hollywood Southern Regional Wastewater Temporary Sodium Hypochlorite System Volume 2 of 2". The numbers and titles of all Drawings appear on the index sheet of the Drawings. All drawings so enumerated shall be considered an integral part of the Contract Documents as defined herein. Supplemental drawings developed during construction as may be

required to be submitted by the Contractor per the specifications shall also be considered a part of the Contract Documents, along with all supplemental drawings issued as part of the response to requests for information (RFIs) during construction or as approved by change order during construction.

D. Contractor shall perform the work in accordance with the Contract Documents, and in accordance with applicable local and national building codes. Where there is an apparent discrepancy between the Drawings, Specifications, or any local and/or national codes, the more stringent of the requirements shall apply unless otherwise approved by the Engineer.

1.04 CONSTRUCTION CONTRACTS, OTHER PROJECTS (NOT USED)

1.05 WORK BY OTHERS (NOT USED)

1.06 WORK BY OWNER

A. Owner will perform the following in connection with the Work:

1. Operate all existing valves, gates, pumps, equipment, and appurtenances that will affect Owner's operation, unless otherwise specified or indicated.

1.07 OWNER-FURNISHED EQUIPMENT AND MATERIALS (NOT USED)

1.08 OWNER ASSIGNED PROCUREMENT DOCUMENTS (NOT USED)

1.09 OWNER PRE-SELECTED EQUIPMENT AND MATERIALS (NOT USED)

1.10 SEQUENCE AND PROGRESS OF WORK

A. Requirements for sequencing and coordinating with Owner's operations, including maintenance of plant operations during construction, and requirements for tie-ins and shutdowns, are in Section 01 14 00 – Coordination with Owner's Operations.

1.11 CONTRACTOR'S USE OF SITE

A. Contractors' use of the Site shall be confined to the areas shown. Contractors shall share use of the Site with City personnel as required to maintain operations.

B. Contractor shall move stored products that interfere with operations of Owner, or others performing work for Owner.

1.12 EASEMENTS AND RIGHTS-OF-WAY

A. Easements and rights-of-way will be provided by Owner in accordance with the General Conditions. Confine construction operations to within Owner's property, public rights-of-

way, easements obtained by Owner, and the limits shown. Use care in placing construction tools, equipment, excavated materials, and products to be incorporated into the Work to avoid damaging property and interfering with traffic. Do not enter private property outside the construction limits without permission from the owner of the property.

1.13 NOTICES TO OWNERS AND AUTHORITIES OF PROPERTIES ADJACENT TO THE WORK

A. Notify owners of adjacent property and utilities when execution of the Work may affect their property, facilities, or use of property.

B. When it is necessary to temporarily obstruct access to property, or when utility service connection will be interrupted, provide notices sufficiently in advance to enable affected persons to provide for their needs. Conform notices to Laws and Regulations and, whether delivered orally or in writing, include appropriate information concerning the interruption and instructions on how to limit inconvenience caused.

C. Notify utility owners and other concerned entities at least 48 hours prior to cutting or closing streets or other traffic areas or excavating near Underground Facilities or exposed utilities.

1.14 SALVAGE OF EQUIPMENT AND MATERIALS

A. Existing equipment and materials removed and not shown or specified to be reused in the Work will be Contractor’s property.

B. Existing equipment and material removed by Contractor shall not be reused in the Work, except where specified or indicated.

C. Carefully remove in a manner to prevent damage to all equipment and materials specified or indicated to be salvaged and reused or to remain property of Owner. Store and protect salvaged items specified or indicated to be used in the Work. Replace in kind or with new items equipment, materials, and components damaged in removal, storage, or handling through carelessness or improper procedures.

D. Contractor may furnish and install new items, with Engineer’s approval, instead of those specified or indicated to be salvaged and reused, in which case such removed items will become Contractor’s property.

1.15 PARTIAL UTILIZATION BY OWNER

A. Owner reserves the right to enter and use portions of the Work prior to issuance of Certificate of Substantial Completion by Engineer.

B. Owner shall be responsible to prevent premature connections by private and public parties, persons or groups of persons, before Engineer issues Certificate of Substantial Completion for the portion of Work being partially utilized by Owner.

C. Contractor shall cooperate with Owner, Owner's agents, and Engineer to accelerate completion of Work designed for partial utilization by Owner in accordance with Contractor's progress schedule.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

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SECTION 01 14 00

COORDINATION WITH OWNER'S OPERATIONS.

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Requirements for coordinating with Owner's operations during the Work and included requirements for tie-ins and shutdowns necessary to complete the Work without impact on Owner's operations except as allowed in this Section.

2. Contractor shall provide labor, materials, tools, equipment and incidentals shown, specified and required to coordinate with Owner's operations during the Work.

B. General Requirements:

1. Except for shutdowns specified in this Section, perform the Work such that Owner's facility remains in continuous satisfactory operation during the Project. Schedule and conduct the Work such that the Work does not: impede Owner's production or processes, create potential hazards to operating equipment and personnel, reduce the quality of the facility's products or effluent, or cause odors or other nuisances.

2. Work not specifically covered in this Section or in referenced Sections may, in general, be completed at any time during regular working hours in accordance with the General Conditions and Supplementary Conditions, subject to the requirements in this Section.

3. Contractor has the option of providing additional temporary facilities that can eliminate or mitigate a constraint without additional cost to Owner, provided such additional temporary facilities: do not present hazards to the public, personnel, structures, and equipment; that such additional temporary facilities do not adversely affect Owner's ability to comply with Laws and Regulations, permits, and operating requirements; that such temporary facilities do not generate or foster the generation of odors and other nuisances; and that requirements of the Contract Documents are fulfilled.

4. Coordinate shutdowns with Owner and Engineer. When possible, combine multiple tie-ins into a single shutdown to minimize impacts on Owner's operations and processes.

5. Do not shut off or disconnect existing operating systems, unless accepted by Engineer in writing. Operation of existing equipment will be by Owner unless otherwise specified or indicated. Where necessary for the Work, Contractor shall seal or bulkhead Owner-operated gates and valves to prevent leakage that may affect the Work, Owner's operations, or both. Provide temporary watertight plugs, bulkheads, and line stops as required. After completing the Work, remove seals, plugs, bulkhead, and line stops to satisfaction of Engineer.

C. Continuous Treatment Provision:

1. Federal regulations prohibit bypassing of untreated or partially treated wastewater or sewage during construction Work.

2. Contractor shall provide labor, equipment, materials, and incidentals to provide continuous treatment to the level prior to construction Work.

3. Contractor shall be responsible for providing temporary pumping facilities, systems, piping, valve, appurtenances, equipment, materials, and temporary utilities necessary to complete the Work without treatment bypassing.

D. Related Sections:

1. Section 01 11 00 – Summary of Work

2. Section 01 25 00 – Substitution Procedures

3. Section 01 73 00 – Demolition and Execution of Work

1.02 REFERENCES

A. Definitions: A "shutdown" is when a portion of the normal operation of Owner's facility, whether equipment, systems, piping, or conduit, has to be temporarily suspended or taken out of service to perform the Work.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Review installation procedures under other Specification sections and coordinate Work that must be performed with or before the Work specified in this Section.

2. Notify other contractors in advance of Work requiring coordination with Owner's operations, to provide other contractors sufficient time for work included in their contracts that must be installed with or before Work specified in this Section.

3. When possible, combine multiple tie-ins into a single shutdown to minimize impacts on Owner's operations and processes.

B. Pre-Shutdown Meetings: Contractor shall schedule and conduct meeting with Owner and Engineer prior to scheduling shutdown.

C. Sequencing:

1. Perform the Work in the specified sequence. Certain phases or stages of the Work may require working 24-hour days or work during hours outside of regular working hours. Work may be accelerated from a later stage to an earlier stage if Owner's operations are not adversely affected by proposed sequence change, with Engineer's acceptance. Stages specified in this Section are sequential in performance of the Work.

D. Scheduling:

1. Work that may interrupt normal operations shall be accomplished at times convenient to Owner.

2. Furnish at the Site, in proximity to the shutdown and tie-in work areas, tools, equipment, spare parts and materials, both temporary and permanent, necessary to successfully complete the shutdown. Complete to the extent possible, prefabrication of piping and other assemblies prior to the associated shutdown. Demonstrate to Engineer's satisfaction that Contractor has complied with these requirements before commencing the shutdown.

3. If Contractor's operations cause an unscheduled interruption of Owner's operations, immediately re-establish satisfactory operation for Owner.

4. Unscheduled shutdowns or interruptions of continued safe and satisfactory operation of Owner's facilities that result in fines or penalties by authorities having jurisdiction shall be paid solely by Contractor if, in Engineer's opinion, Contractor did not conform to the requirements of the Contract Documents, or was negligent in the Work, or did not exercise proper precautions in conducting the Work.

5. Work requiring service interruptions for tie-ins shall be performed during scheduled shutdowns.

6. Temporary, short-term shutdowns of smaller piping, conduits, equipment, and systems may be required. Coordinate requirements for such shutdowns with Engineer and Owner.

1.04 SUBMITTALS

A. Action/Informational Submittals:

1. Substitute Sequence Submittal: When deviation from specified sequence is proposed, provide submittal explaining in detail the proposed sequence change and its effects, including evidence that Owner's operations will not be adversely affected by proposed change. List benefits of proposed sequence change, including benefits to Progress Schedule. Submit in accordance with Section 01 25 00 – Substitution Procedures.

2. Shutdown Planning Submittal:

    a. For each shutdown, submit an inventory of labor and materials required to perform the shutdown and tie-in tasks, an estimate of time required to accomplish the complete shutdown including time for Owner to take down and start up existing equipment, systems, or conduits, and written description of steps required to complete the Work associated with the shutdown.

    b. Furnish submittal to Engineer at least thirty (30) days prior to proposed shutdown start date. Do not start shutdown until obtaining Engineer's acceptance of shutdown planning submittal.

3. Shutdown Notification: After acceptance of shutdown planning submittal and prior to starting the shutdown, provide written notification to Owner and Engineer of date and time each shutdown is to start. Provide notification at least 72 hours in advance of each shutdown.

1.05 SITE CONDITIONS

A. General Constraints: Specified in the Contract Documents are the sequence and shutdown durations, where applicable, for Owner's equipment, systems, and conduits that are to be taken out of service temporarily for the Work. New equipment, materials, and systems may be used by Owner after the specified field quality controls and testing are successfully completed and the materials or equipment are Substantially Complete.

B. The following constraints apply to coordination with Owner's operations:

1. Operational Access: Owner's personnel shall have access to equipment and areas that remain in operation.

2. Schedule and perform equipment and system start-ups for Monday through Thursday. Equipment and systems shall not be placed into operation on Friday, Saturday, and Sunday without prior approval of Owner.

3. Dead End Valves or Pipe: Provide blind flanges, watertight bulkheads, or valves at temporary and permanent terminuses of pipes and conduits. Blind flanges and bulkheads shall be suitable for the service and braced and blocked, as required, or otherwise restrained as directed by Engineer. Temporary valves shall be suitable

for their associated service. Where valve is provided at permanent terminus of pipe or conduit, also provide on downstream side of valve a blind flange with drain/flushing connection.

4. Owner will assist Contractor to the extent practical in dewatering process tanks, basins, conduits, and other work areas to be dewatered for shutdowns. Maintain clean and dry work area by pumping and properly disposing of fluid that accumulates in work areas.

5. Owner will pump out diesel fuel from existing diesel fuel storage tank to the extent practical. The Contractor is advised there may be some remaining fuel in this tank prior to demolition activities.

6. Draining and Cleaning of Conduits, Tanks, and Basins: Unless otherwise specified, Owner will be responsible for draining of any basins and utility isolation via isolation valve operation prior to shutdown. The Contractor shall be responsible for pumping out/removing the remaining contents of affected, tanks, basins, and piping as required to successfully perform the work prior to commencing associated work. All contents shall be disposed of in accordance with all regulatory requirements. Draining and cleaning conducted by Contractor shall be as specified below:

    a. Contractor shall remove liquids and solids and dispose of them in accordance with all regulatory requirements. With prior written approval from Owner, liquid contents of pipes, tanks, basins, and conduits undergoing modifications may be transferred to a process tank or basin identified by Owner with capacity sufficient to accept such discharges, using hoses, piping, pumps, or other means provided by Contractor. All proposed disposal facilities shall be approved by the Owner.

    b. If drainage point is not available on the piping or conduit to be drained, provide a wet tap using tapping saddle and valve or other method approved by Engineer. Uncontrolled spillage of pipe's or conduit's contents is not allowed.

    c. Spillage shall be brought to Engineer's attention immediately, both verbally and in writing, and reported in accordance with Laws and Regulations. Contractor shall wash down spillage to floor drains or sumps and flush the system to prevent clogging and odors. If spillage is not suitable for discharge to the drainage system, such as chemical spills, as determined by Engineer, Contractor shall remove spillage by other method, such as vactor truck, acceptable to Engineer.

1. Electrical, Control, Communication, and Monitoring Systems:

a. Owner's existing SCADA system and fiber optic network shall remain functional, subject to the constraints herein.

b. The Contractor shall submit a detailed Work Plan to the Engineer for review and approval prior to connecting the new temporary system to the Owner's SCADA or electrical infrastructure.

c. Once the temporary sodium hypochlorite system is energized and online, continuous communication to all related PLC panels, instruments, and SCADA interfaces shall be maintained. Any disruption to SCADA connectivity after startup shall require prior written approval and shall follow the approved shutdown procedure.

d. Each process area shall be permitted to have a single, non-concurrent, scheduled outage for the purpose of making PLC panel hardware modifications, loading the associated PLC logic, and its field testing/demonstration if needed. Field testing and demonstration shall immediately follow modifications in an effort to keep scheduled shutdowns as short as possible. A 14-day period of no SCADA outage shall proceed each scheduled shutdown.

1.06 SUGGESTED SEQUENCE OF WORK

A. The following represent suggested construction stages of the Contractor's work:

1. Stage 1. Demolition and rerouting of existing piping.

2. Stage 2. Construction of the Temporary Sodium Hypochlorite facilities.

3. Stage 3. Start-up, commissioning, and testing of the new facilities.

4. Stage 4. Shutdown of the existing gas chlorine system.

5. Stage 5. Closeout activities.

~~A.~~**B.** Perform the Work in the specified sequence or as otherwise approved by Engineer. Certain phases or stages of the Work may require working 24-hour days or work during hours outside of regular working hours. Work may be accelerated from a later stage to an earlier stage if Owner's operations are not adversely affected by proposed sequence change, and with Engineer's acceptance.

~~B.~~**C.** Critical events in the sequence of construction are specified herein. The outlined sequence of construction does not include all items necessary to complete the Work, but is intended to identify the sequence of critical events necessary to eliminate disruption to the Owner's facilities. It shall be understood by the Contractor that the critical events identified are not all inclusive and that additional items of work not shown are required.

The sequence of construction is a precedence requirement and does not attempt to schedule the Contractor's work.

~~C.~~**D.** Detailed Sequence of Construction and Operational Constraints

1. Mobilization and Site Preparation:

    a. Obtain permits, develop and submit construction schedule, schedule of values, hurricane preparedness/action plan, plan of operations, shop drawing schedule, set up staging area, and mobilize for work

    b. Complete pre-construction video and perform field investigations/locates of existing utilities that may be impacted by the work

    c. Complete all pre-construction requirements

2. Temporary Sodium Hypochlorite System:

    a. Prior to the start of construction of the new Temporary Sodium hypochlorite Facility, the following work must be performed:

        1) Site demolition of paving and other structures in the vicinity of the work.

        2) Permanent relocation of the existing 6" and 16" NPW pipelines and 6" PW pipeline affected by the footprint of the new Facility.

        3) Temporary relocation of three (3) existing 3" CLS pipelines to the Reuse and Non-Potable Filter Pre-Chlorination and Chlorine Contact Tank Dosing locations. Temporary highlines or other suitable means of disinfectant dosing must be implemented by the Contractor to allow Owner the ability maintain chlorine dosing to these locations.

    b. The existing gas chlorination and chlorine solution water system at the Chlorine Building are critical components of the Owner's wastewater treatment plant system and shall remain in service, at all times to critical portions of the facility including the Outfall Pump Station (via the Hydraulic Box), Reuse and Non-Potable Filters Pre-Chlorination, Reuse Chlorine Contact Tank, and Non-Potable Chlorine Contact Tank**s**. ~~s~~Temporary shutdowns that affect these operations must be coordinated with the Owner and Engineer.

    c. The Contractor shall notify the Owner in writing 14 calendar days in advance of any work done to the Temporary Sodium Hypochlorite System that will impact operation of the existing chlorine solution water system.

d. The Temporary Sodium Hypochlorite System shall be installed as described in the Contract Documents. Successful completion of 30 **days** consecutive and continuous days of satisfactory ~~operation~~**shall be provided to confirm performance** shall be provided to confirm performance of the continuous chlorine dosing location~~s.~~ **points.** Failure results in re-start of 30-day period. Successful completion of 7 **days** consecutive and continuous days of satisfactory operation shall be provided to confirm performance of the intermittent chlorine dosing location ~~s.~~**points.** Failure results in re-start of 7-day period. The Contractor may assist Owner in shutting down the existing gas chlorination system at the Chlorine Building. (**Note: This Project DOES NOT include demolition or equipment removals of any portion of the existing gas chlorination system within the Chlorine Building**).

e. Complete all work at the locations of new NaOCl ~~Injection~~ **injection** ~~Dosing Stations~~**locations**, including ~~new~~ **the installation of the new** NaOCl dosing lines ~~installations, sump drain installations, and new CLS pipeline tie-ins to existing CLS dosing locations~~ as shown on the Contract Documents. Upon successful completion of 30 consecutive and continuous days of satisfactory operation for continuous dosing locations, and 7 consecutive and continuous days for intermittent dosing locations of the Temporary Sodium Hypochlorite System, the Contractor shall be permitted to proceed with the abandonment and/or removal of the affected portions of the existing CLS piping from the Chlorine Building.

~~**Complete all work at the locations of new NaOCl Injection Dosing Stations, including new NaOCl dosing lines installations, sump drain installations, and new CLS pipeline tie-ins to existing CLS dosing locations as shown on the Contract Documents. Upon completion of the 30 (continuous locations) and 7 (intermittent locations) consecutive and continuous days of satisfactory operation of Temporary Sodium Hypochlorite System, the Contractor may complete abandonments and/or removals of affected portions of the existing CLS piping from the Chlorine Building.**~~

3. Tie-Ins:

a. See Scheduled Shutdowns in paragraph 3.02 and Schedule of Tie-Ins in Table 01 14 00-A of this Section for specific items of work.

b. The Contractor shall notify the Owner in writing 14 calendar days in advance of tie-in work.

c. Tie-ins to existing piping shall occur during non-peak periods. Non-peak periods are anticipated to occur between 10PM and 5AM daily. Contractor shall plan construction activities for Tie-In Nos. 5, 6, and 7 (See Table

01 14 00-A) such that operation is interrupted on no more than two occasions for up to four hours on each occasion.

d. The New Temporary Sodium Hypochlorite Facility shall be installed, tested, and cleared for operation by the Florida Department of Environmental Protection and Broward County Resilient Environment Department prior to being placed into operation.

e. New Temporary Sodium Hypochlorite Facility shall be placed into operation and complete operational testing prior to taking the Existing Chlorine Gas System off-line and abandoning in place.

4. Project Closeout

a. Complete final ~~punchlist~~**punch list** items

b. Complete project closeout activities in accordance with Section 01 77 19

c. Final acceptance of project

d. Commence warranty period

1.07 SHUTDOWNS

A. General:

1. Work that may interrupt normal operations shall be accomplished at times convenient to Owner.

2. Furnish at the Site, in proximity to the shutdown and tie-in work areas, tools, equipment, spare parts and materials, both temporary and permanent, necessary to successfully complete the shutdown. Complete to the extent possible, prefabrication of piping and other assemblies prior to the associated shutdown. Demonstrate to Engineer's satisfaction that Contractor has complied with these requirements before commencing the shutdown.

3. If Contractor's operations cause an unscheduled interruption of Owner's operations, immediately re-establish satisfactory operation for Owner.

4. Unscheduled shutdowns or interruptions of continued safe and satisfactory operation of Owner's facilities that result in fines or penalties by authorities having jurisdiction shall be paid solely by Contractor if, in Engineer's opinion, Contractor did not conform to the requirements of the Contract Documents, or was negligent in the Work, or did not exercise proper precautions in conducting the Work.

5. Shutdowns shall be in accordance with paragraph 3.02 of this Section. Work requiring service interruptions for tie-ins shall be performed during scheduled shutdowns.

1.08 PLAN OF OPERATION

A. Contractor shall submit a detailed, written Work Plan for each detailed sequence item described below to the Owner and the Engineer for their review and approval. The Work Plan shall be submitted at least four weeks prior to commencing the work described. The Work Plan shall address the following items:

1. Step by step detailed sequence for performing the work described in Paragraph 1.08 (A), including all activities required by the Owner.

2. Anticipated dates and duration of each activity, including all activities required by the Owner

3. The Work Plan shall include a detailed plan for tie-ins and ~~shut downs~~**shutdowns**

4. Plan and/or schematic drawings to clearly identify work to be performed. Sequence steps shall be identified ~~on~~**in** drawings using a keynote legend or similar means.

5. The Plan of Operation shall include a detailed plan for tie-ins or ~~shut downs~~**shutdowns**. The plan shall list all potential problems and remedies along with spare parts and materials that must be on hand to repair any potential problems.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.01 GENERAL

A. In addition to requirements of this Section, conform to requirements of Section 01 73 00 – Demolition and Execution of Work.

B. Refer to paragraph 3.02 of this Section for detailed shutdown requirements.

C. Refer to Table 01 14 00-A in this Section for detailed tie-in schedule.

3.02 DETAILED SHUTDOWN REQUIREMENTS:

A. Prior to Typical Shutdown:

1. Obtain Engineer's acceptance of proposed shutdown planning submittal and shutdown notification submittal.

2. Submittal and approval of all shop drawings required.

3. Coordinate with plant operations on timing of shutdown and provide required notice to Owner.

4. Bring necessary piping, couplings, valves, equipment, and appurtenances to the work areas.

5. Assist Owner in preparing to take equipment, tanks, basins, and conduits temporarily out of service.

6. Coordinate other tie-ins to be performed simultaneously.

7. Install and ensure the functionality of temporary systems as applicable.

B. During Typical Shutdown:

1. Owner will dewater tanks and basins as required and provide temporary shutdown of portions of the facilities as necessary to allow Contractor's expedited completion of tie-in work.

2. Remove existing equipment, piping, and accessories as required.

3. Verify operation of new equipment, materials, and systems.

4. Following approval from Engineer, return equipment and system to operation with Owner.

C. Following Typical Shutdown:

1. Verify functionality of equipment and system.

2. Verify operation of new equipment and ~~systems, and~~**systems and** verify that joints in piping are watertight or gastight as applicable.

3. Repair joints that are not watertight or gastight as applicable.

4. Remove temporary systems as applicable.

3.03 PROPOSED SHUTDOWN SEQUENCE

A. Shutdown No. 1 Description: 16" NPW Relocation at Chlorine Building

1. General:

a. Impact on Other Equipment and Processes: Shutdown or partial shutdown of the 16” NPW may affect ability to provide primary motive water for the chlorine solution water system at Chlorine Building. Maintain 6” PW connection to Chlorine Building in service to supply backup motive water supply to the chlorine solution water system.

b. Location: East of Chlorine Building and south of new Temporary Sodium Hypochlorite Structure

c. Owner access to Site roadways: Maintain in service during shutdown and relocation of the 16” NPW pipeline.

2. Prior to Shutdown:

a. Obtain Engineer’s acceptance of proposed shutdown planning submittal and shutdown notification submittal.

b. Assist Owner in preparing to take equipment, tanks, basins, and conduits temporarily out of service.

c. Specific requirements: Assist Owner in verifying operation of the backup potable water supply to the Chloring Building including the following:

1) Backflow preventer and booster pump

2) Gas chlorinators and eductor systems

3. During Shutdown:

a. Installation of remaining Work required.

b. Perform disinfection and pressure test.

c. Perform Tie-In No. 1 shown on Table 01 14 00-A. ~~Consider performing Tie-In Nos. 3 and 4 shown on Table 01 14 00-A during this shutdown.~~

d. Verify functionality of equipment and system.

e. Complete trench backfill, compaction and restoration.

4. Following shutdown:

a. Restore 16” NPW to service

B. Shutdown No. 2 Description: 6” PW Relocation at Chlorine Building

1. General:

a. Impact on Other Equipment and Processes: Shutdown or partial shutdown of the 6” PW may affect ability to provide back-up motive water for the chlorine solution water system and supply to eye-wash showers and other potable uses at Chlorine Building. Maintain 16” NPW connection to Chlorine Building in service to supply primary motive water supply to the chlorine solution water system.

b. Location: East of Chlorine Building and south of new Temporary Sodium Hypochlorite Structure

c. Owner access to Site roadways: Maintain in service during shutdown and relocation of the 6” PW pipeline.

2. Prior to Shutdown:

a. Obtain Engineer’s acceptance of proposed shutdown planning submittal and shutdown notification submittal.

b. Assist Owner in preparing to take equipment, tanks, basins, and conduits temporarily out of service.

c. Specific requirements: Assist Owner in verifying operation of the primary non-potable water supply to the Chlorine Building including the following:

1) Backflow preventer and booster pump

2) Gas chlorinators and eductor systems

3. During Shutdown:

a. Installation of remaining Work required.

b. Perform disinfection, bacteriological testing, and pressure test.

c. Perform Tie-In No. 2 shown on Table 01 14 00-A.

d. Verify functionality of equipment and system.

e. Complete trench backfill, compaction and restoration.

4. Following shutdown:

a. Restore 6” PW to service

C. Shutdown No. 3 Description: Install Temporary Highline for 3” CLS from Chorine Building to Filter Prechlorination

1. **General:**

    a. **The existing 3" CLS from Chorine Building to Filter Prechlorination must be temporarily relocated so that the new Temporary Sodium Hypochlorite structure can be constructed.**

    b. **Impact on Other Equipment and Processes: Shutdown of the 3" CLS from Chorine Building to Filter Prechlorination will affect the ability to chlorinate the Reuse Filtered Water. Shutdown cannot occur until the new Sodium Hypochlorite dosing line and injection points for the Reuse and Non-Potable CCTs has been constructed and ready for service.**

    c. **Location: West of Reuse and Non-Potable Filter Chlorine Contact Tanks**

    d. **Owner access to Site roadways: Portions of the maintenance roadway adjacent to west side of the CCTs will require shutdown due to open trench excavation.**

2. **Prior to Shutdown:**

    a. **Obtain Engineer's acceptance of proposed shutdown planning submittal and shutdown notification submittal.**

    b. **Assist Owner in preparing to take equipment, tanks, basins, and conduits temporarily out of service.**

    c. **Specific requirements: Assist Owner in shutting down, isolating, and abandoning existing 3" CLS from Chorine Building to Filter Prechlorination.**

3. **During Shutdown:**

    a. **Installation of required temporary highline.**

    b. **Perform pressure test of new temporary highline.**

    c. **Perform Tie-In No. 3 shown on Table 01 14 00-A.**

    d. **Restore functionality of the CLS feed to the Filter Prechlorination system.**

4. **Following shutdown:**

a. In coordination with Owner and Engineer, test and place new existing system to Filter Prechlorination into service.

~~C.~~**D.** Shutdown No. ~~3~~ **4** Description: **Install Temporary Highline for** 3" CLS from Chorine Building to Reuse CCT

1. General:

   a. The existing 3" CLS from Chorine Building to Reuse CCT must be temporarily relocated so that the new Temporary Sodium Hypochlorite structure can be constructed.

   ~~a.~~**b.** Impact on Other Equipment and Processes: Shutdown of the 3" CLS from Chorine Building to Reuse CCT will affect the ability to chlorinate the Reuse Filtered Water. Shutdown cannot occur until the ~~New~~ **new** ~~NaOCl Dosing Station~~**Sodium Hypochlorite dosing line and injection points** for the Reuse and Non-Potable CCTs has been constructed and ready for service.

   ~~b.~~**c.** Location: West of Reuse and Non-Potable Filter Chlorine Contact Tanks

   ~~c.~~**d.** Owner access to Site roadways: Portions of the maintenance roadway adjacent to west side of the CCTs will require shutdown due to open trench excavation.

2. Prior to Shutdown:

   a. Obtain Engineer's acceptance of proposed shutdown planning submittal and shutdown notification submittal.

   b. Assist Owner in preparing to take equipment, tanks, basins, and conduits temporarily out of service.

   c. Specific requirements: Assist Owner in shutting down, isolating, and abandoning existing 3" CLS from Chorine Building to Reuse CCT.

3. During Shutdown:

   a. Installation of remaining Work required.

   b. Perform disinfection and pressure test of new piping.

   c. Perform Tie-In No. ~~5~~ **4** shown on Table 01 14 00-A.

   d. Verify functionality of equipment and system.

   e. Complete trench, backfill, compaction and restoration.

4. Following shutdown:

    a. In coordination with Owner and Engineer, test and place new disinfection system to Reuse CCT into service.

~~D.~~**E.** Shutdown No. 4 ~~5~~ **5** Description: **Install Temporary Highline for** 3" CLS from Chorine Building to Non-Potable CCT

1. General:

    a. The existing 3" CLS from Chorine Building to Non-Potable CCT must be temporarily relocated so that the new Temporary Sodium Hypochlorite structure can be constructed.

    ~~a.~~**b.** Impact on Other Equipment and Processes: Shutdown of the 3" CLS from Chorine Building to Non-Potable CCT will affect the ability to chlorinate the Non-Potable Filtered Water. Shutdown cannot occur until the New NaOCl Dosing Station for the Reuse and Non-Potable CCTs has been constructed and ready for service.

    ~~b.~~**c.** Location: West of Reuse and Non-Potable Filter Chlorine Contact Tanks

    ~~c.~~**d.** Owner access to Site roadways: Portions of the maintenance roadway adjacent to west side of the CCTs will require shutdown due to open trench excavation.

2. Prior to Shutdown:

    a. Obtain Engineer's acceptance of proposed shutdown planning submittal and shutdown notification submittal.

    b. Assist Owner in preparing to take equipment, tanks, basins, and conduits temporarily out of service.

    c. Specific requirements: Assist Owner in shutting down, isolating, and abandoning existing 3" CLS from Chorine Building to Non-Potable CCT.

3. During Shutdown:

    a. Installation of remaining Work required.

    b. Perform disinfection and pressure test of new piping.

    c. Perform Tie-In No. 6 shown on Table 01 14 00-A.

    d. Verify functionality of equipment and system.

e. Complete trench, backfill, compaction and restoration.

4. Following shutdown:

a. In coordination with Owner and Engineer, test and place new disinfection system to Non-Potable CCT into service.

~~E. Shutdown No. 5 Description: 6" CLS from Chorine Building to Hydraulic Box~~

~~1. General:~~

~~a. Impact on Other Equipment and Processes: Shutdown of the 6" CLS from Chorine Building to Hydraulic Box will affect the ability to chlorinate the secondary effluent to the Outfall Pump Station. Shutdown cannot occur until the New NaOCl Dosing Station for the Hydraulic Box and Injection Well Diversion Structures has been constructed and ready for service. Consider sending all secondary effluent to the Injection Well System. The Injection Well System is expected to be able to accept all dry weather secondary effluent flows by 4th quarter of 2025.~~

~~b. Location: North end of Hydraulic Box at the Filter Feed and Outfall Pump Stations.~~

~~c. Owner access to Site roadways: Portions of the maintenance roadway north of the Chlorine Building may require temporary shut down due open trench excavation across roadway.~~

~~2. Prior to Shutdown:~~

~~a. Obtain Engineer's acceptance of proposed shutdown planning submittal and shutdown notification submittal.~~

~~b. Assist Owner in preparing to take equipment, tanks, basins, and conduits temporarily out of service.~~

~~c. Specific requirements:~~

~~1) Assist Owner in diverting secondary effluent flows to Injection Well System.~~

~~2) Provide temporary means for emergency dosing of bulk sodium hypochlorite at the Hydraulic Box in case of wet weather event or to otherwise prevent unchlorinated secondary effluent flows to the outfall.~~

~~3) Assist Owner in shutting down, isolating, and abandoning existing 6"CLS from Chorine Building to Hydraulic Box.~~

3. During Shutdown:

a. Installation of remaining Work required.

b. Perform pressure test of new piping.

c. Perform Tie-In No. 7 shown on Table 01 14 00-A.

d. Verify functionality of equipment and system.

e. Complete trench, backfill, compaction and restoration.

4. Following shutdown:

a. In coordination with Owner and Engineer, test and place new disinfection system to Hydraulic Box into service.

F. Shutdown No. 6 Description: 3" CLS from Chorine Building to Injection Well Diversion Structure

1. General:

a. Impact on Other Equipment and Processes: Shutdown of the 3" CLS from Chorine Building to Injection Well Diversion Structure will affect the ability to perform maintenance chlorination of the secondary effluent to the Injection Well System. Shutdown cannot occur until the New NaOCl Dosing Station for the Hydraulic Box and Injection Well Diversion Structures has been constructed and ready for service. Chlorination at this location is for maintenance purposes only and is not critical to the operation of the Injection Well System

b. Location: Injection Well Diversion Structure at south end of Secondary Clarifiers.

c. Owner access to Site roadways: Portions of the maintenance roadway south of the Secondary Clarifiers may partially impacted but not completely shutdown due open trench excavation across roadway.

2. Prior to Shutdown:

a. Obtain Engineer's acceptance of proposed shutdown planning submittal and shutdown notification submittal.

b. Assist Owner in preparing to take equipment, tanks, basins, and conduits temporarily out of service.

c. Specific requirements:

~~1) Assist Owner in shutting down, isolating, and abandoning portions of the existing 3"CLS from isolation valve to the Injection Well Diversion Structure.~~

~~3. During Shutdown:~~

~~a. Installation of remaining Work required.~~

~~b. Perform pressure test of new piping.~~

~~c. Perform Tie-In No. 8 shown on Table 01 14 00-A.~~

~~d. Verify functionality of equipment and system.~~

~~e. Complete trench, backfill, compaction and restoration.~~

~~4. Following shutdown:~~

~~a. In coordination with Owner and Engineer, test and place new disinfection system to Injection Well Diversion Structure into service.~~

~~G.~~**F.** Shutdown No. ~~7~~ **6** Description: 3" CLS from Chorine Building to Headworks Odor Control

1. General:

   a. Impact on Other Equipment and Processes: Shutdown of the 3" CLS from Chorine Building to Headworks Odor Control may temporarily affect the odor removal efficiency of the Odor Control System which relies on sodium hydroxide and sodium hypochlorite for high levels of odor removal. The Odor Control System will still function on sodium hydroxide only until sodium hypochlorite injection is restored.

   b. Location: Headworks Odor Control System.

   c. Owner access to Site roadways: Portions of the maintenance roadways along the alignment of the new double containment pipe installation may be partially impacted but not completely shutdown due open trench excavation along the affected roadways. Contractor will need to coordinate site roadway access and temporary closures with Owner.

2. Prior to Shutdown:

   a. Obtain Engineer's acceptance of proposed shutdown planning submittal and shutdown notification submittal.

   b. Assist Owner in preparing to take equipment, tanks, basins, and conduits temporarily out of service.

c. Specific requirements:

1) Assist Owner in shutting down, isolating, and abandoning the existing 3” CLS from the Chlorine Building to the Headworks odor Control.

3. During Shutdown:

a. Installation of remaining Work required.

b. Perform pressure test of new piping.

c. Perform Tie-In No. ~~9~~ **6** shown on Table 01 14 00-A.

d. Verify functionality of equipment and system.

e. Complete trench, backfill, compaction and restoration.

4. Following shutdown:

a. In coordination with Owner and Engineer, test and place new disinfection system to Headworks Odor Control into service.

~~H.~~**G.** Shutdown No. 3 Description: Five (5) 3” CLS pipelines at Chorine Building for RAS 1, 2, 3, and 4, and Influent Pump Station

1. General:

a. Impact on Other Equipment and Processes: Temporary shutdown of the respective 3” CLS pipelines at the Chorine Building to RAS 1, 2, 3, and 4, and Influent Pump Station will prevent to ability to send chlorine to the respective processes for maintenance purposes. However, Owner has noted that this is not critical as maintenance injection of chlorine at the respective processes are not performed on a regular basis.

b. Location: South wall of Chlorine Building near east end.

c. Owner access to Site roadways: No site roadways will be impacted

2. Prior to Shutdown:

a. Obtain Engineer’s acceptance of proposed shutdown planning submittal and shutdown notification submittal.

b. Assist Owner in preparing to take equipment, tanks, basins, and conduits temporarily out of service.

c. Specific requirements:

1) Assist Owner in shutting down and isolating the affected existing 3" CLS pipelines for RAS 1, 2, 3, and 4, and Influent Pump Station.

2) Partially remove existing outer insulation cover or secondary containment pipe on vertical CLS pipes to the proposed locations for new injector installations.

3. During Shutdown:

a. Install new injectors into the vertical legs of each of the affected 3" CLS lines.

b. Install new RAS 1, 2, 3, **4 and** ~~4~~ **5** Dosing Valve Diverter Panel

c. Install remaining Work required.

d. Perform pressure test of new piping.

e. Perform Tie-In Nos. ~~10~~ **7** and ~~11~~ **8** shown on Table 01 14 00-A.

f. Verify functionality of equipment and system.

g. Complete trench, backfill, compaction and restoration.

4. Following shutdown:

a. In coordination with Owner and Engineer, test and place new disinfection system to RAS 1, 2, 3, and 4, and Injection Pump Station into service.

Table 01 14 00-A
Schedule of Tie-Ins

Tie-In No.	New Line Size and Service	Existing (Connecting) Line Size & Service	Tie-In Building/Location	Construction Stage	Remarks
1	16” NPW	16” NPW	Chlorine Building	1	Realign existing 16” NPW
2	6” PW	6” PW	Chlorine Building	1	Realign existing 6” PW
~~3~~	~~4” NPW~~	~~16” NPW~~	~~New NaOCl Dosing Station for Reuse and Non-Potable CCTs~~	~~1~~	~~Hot tap to keep 16” NPW in service~~
~~4~~	~~4” NPW~~	~~16” NPW~~	~~New NaOCl Dosing Station for Hydraulic Box & Injection Well Diversion Structures~~	~~1~~	~~Hot tap to keep 16” NPW in service~~
3	**Not Applicable**	**3” CLS from Chlorine Building to Filter Prechlorination (Reuse and Non-Potable)**	**Filter Prechlorination**	**1**	**Existing 3” CLS from Chlorine Building to Filter Prechlorination must be temporarily shut down to allow installation of temporary highline in the vicinity of the new Temporary Hypochlorite Structure.**
~~5~~**4**	**Not Applicable**~~3” CLS from New NaOCl Dosing Station for Reuse CCT~~	3” CLS from Chorine Building to Reuse CCT	Reuse CCT	~~3~~**1**	Existing 3” CLS from Chlorine Building to Reuse CCT **must be temporarily shut down to allow installation of temporary highline in the vicinity of the new Temporary Hypochlorite Structure.**~~must be shutdown and taken out of service to perform new tie-in.~~

Table 01 14 00-A
Schedule of Tie-Ins

Tie-In No.	New Line Size and Service	Existing (Connecting) Line Size & Service	Tie-In Building/Location	Construction Stage	Remarks
~~6~~**5**	**Not Applicable**~~3" CLS from New NaOCl Dosing Station for Non-Potable CCT~~	3" CLS from Chorine Building to Non-Potable CCT	Non-Potable CCT	~~3~~**1**	Existing 3" CLS from Chlorine Building to Non-Potable CCT **must be temporarily shut down to allow installation of temporary highline in the vicinity of the new Temporary Hypochlorite Structure.**~~must be shutdown and taken out of service to perform new tie-in.~~
~~7~~	~~6" CLS from New NaOCl Dosing Station for Hydraulic Box~~	~~6" CLS from Chorine Building to Reuse CCT~~	~~Hydraulic Box upstream of Filter Feed and Outfall Pump Stations~~	~~3~~	~~Existing 6" CLS from Chlorine Building to Hydraulic Box must be shutdown and taken out of service to perform new tie-in.~~
~~8~~	~~3" CLS from New NaOCl Dosing Station for Injection Well Diversion Structure~~	~~3" CLS from Chlorine Building to Injection Well Diversion Structure~~	~~Injection Well Diversion Structure~~	~~3~~	~~Confirm that existing 3" CLS to Injection Well Diversion Structure can be isolated from main line via isolation valve. Otherwise, entire 3" CLS will need to be shutdown from Chlorine Building to new tie-in.~~
~~9~~**6**	2" Dbl Containment Pipe with 0.375" I.D. NaOCl Carrier Tubing from New Headworks Odor Control Meter Pumps	3" CLS	Headworks Odor Control	~~3~~**2**	Replace existing 3" CLS from Chlorine Building to Headworks Odor Control with New NaOCl. Coordinate tie-in location with separate Headworks Odor Control Contractor.

Table 01 14 00-A
Schedule of Tie-Ins

Tie-In No.	New Line Size and Service	Existing (Connecting) Line Size & Service	Tie-In Building/Location	Construction Stage	Remarks
~~10~~**7**	~~3~~**2**" Dbl Containment Pipe with 0.~~75~~**5**" I.D. NaOCl Carrier Tubing from new RAS 1,2,3,4 Metering Pump	3" CLS to RAS 1, 2, 3, & 4	Chlorine Building	~~4~~ **2**	Existing 3" CLS lines to RAS 1, 2, 3, and 4 at Chlorine Building must be shutdown and taken out of service to perform new dosing point tie-ins. -Install RAS Dosing Diverter Valve Panel on wall upstream of tie-in points.
~~11~~**8**	~~3~~**2**" Dbl Containment Pipe with 0.~~75~~**5**" I.D. NaOCl Carrier Tubing from new Influent Pump Station Metering Pump	3" CLS to Influent Pump Station	Chlorine Building	~~4~~ **2**	Existing 3" CLS lines to Influent Pump Station at Chlorine Building must be shutdown and taken out of service to perform new dosing point tie-in.

~~**END OF SECTION**~~

END OF SECTION

SECTION 40 05 65.23
CHECK VALVES

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. Reference Section 40 05 00 – Basic Mechanical Requirements.

B. Valves intended for chemical service shall be constructed of materials suitable for the intended service.

PART 2 – PRODUCTS

2.01 FLANGE INSERT CHECK VALVES (CV-FI)

A. The Contractor shall provide flange insert check valves (FIVs) for installation in the vertical overflow lines of bulk storage and day tanks located inside. The valves shall be designed for insertion between two mating ANSI flanges, and valve size shall match tank overflow line size. Flanges and gaskets shall be provided by the Contractor. Valve bodies shall be constructed of PVC, valve seats shall be constructed of Viton, and metal springs shall be constructed of Alloy C-276 or FEP-encapsulated SS. Each valve shall have a cracking pressure of 1/2 psig. Flange insert check valves shall be as manufactured by Check-All Valve Manufacturing Company, or equal.

2.02 DUCKBILL CHECK VALVES (TF-2)

~~A.~~ **The Contractor shall provide duckbill check valves for installation in the 1" CPVC with 0.5" CPVC nipple pipes in the Outfall Pump Station Hydraulic Box and Hydraulic Structure of the Injection Well. The duckbill check valves shall also be provided for the 0.5" CPVC drop pips locations to the injectors of the Non-Potable Prechlorination, Non-Potable CCT, Reuse Prechlorination, and Reuse CCT. Flanges and gaskets shall be provided by the Contractor. Valves bodies shall be constructed of FKM and valve seats shall be constructed of Viton. Each valve shall have a cracking pressure of 1/2 psig. Duckbill check valves shall be as manufactured by Red Valve Tideflex® Molded Series TF-2 Duckbill Check Valve, or equal.**

PART 3 – EXECUTION (NOT USED)

12-02-21

END OF SECTION

SECTION 40 06 20
PROCESS PIPE, VALVE, AND GATE SCHEDULES

PART 1 - GENERAL

1.01 THE REQUIREMENT

A. Reference Section 40 05 00 - Basic Mechanical Requirements.

1.02 PIPING SCHEDULES

A. Piping requirements for this Section are outlined on the Drawings and in the Piping Schedules. In the absence of a specified test pressure, pipe shall be tested at the greater of: 1) 150 percent of working pressure as determined by the Engineer or 2) 10 psig, unless the Schedule indicates no test is required.

B. If the pipe material is not shown on the Piping Schedule or otherwise specified, the following materials shall be used.

PIPE SIZE	MATERIAL	TYPE OF JOINT	CLASS/DESIGN	TEST PRESSURE
4-IN AND LARGER	DIP	FLANGED (EXPOSED)	CLASS 53	(1)
		RESTRAINED (BURIED)	PRESSURE CLASS 350	
LESS THAN 4-IN	PVC/CPVC (2)	SOCKET	SCH 80	(1)

(1) Test at 150 percent of working pressure or 10 psi, whichever is greater.
(2) For all PVC / CPVC designations, for this project CPVC shall be used unless PVC is specifically called out on the Drawings.

1.03 VALVE SCHEDULES

A. All valves shall be tagged by the manufacturer according to the control valve designations listed in this Section.

B. Valves not listed in this Section shall be manually operated, unless otherwise shown on the Drawings.

121311

WASTEWATER TREATMENT PLANT PIPING SCHEDULE

PIPE DESIGNATIONS		MATERIAL	BURIED PIPING		EXPOSED PIPING			DESIGN PRESSURE (PSI)[1]			
			TYPE OF JOINT	CLASS/ DESIGN	TYPE OF JOINT	CLASS/ DESIGN	HEAT TRACE[2]	WORKING	SURGE	RESTRAINT	FIELD TEST
NPW	NON-POTABLE (SERVICE) WATER	< 4" PVC / CPVC[3]	SOCKET	SCH 80	SOCKET/ FLANGED	SCH 80	NO	100	125	150	150
		>=4" PVC (replace in kind)	DI MJ RESTRAINED	C900 PC235 DR18	NOT APPLICABLE	NOT APPLICABLE	NO				
		> = 4" DIP (replace in kind)	RESTRAINED	PRESSURE CLASS 350	FLANGED	CLASS 53	NO				
~~PDG~~	~~PROCESS DRAIN GRAVITY~~	~~< 4" PVC / CPVC[3]~~	~~SOCKET~~	~~SCH 80~~	~~SOCKET/ FLANGED~~	~~SCH 80~~	~~NO~~	~~GRAVITY~~	~~NA~~	~~NA~~	~~5[5]~~
		~~> = 4" DIP~~	~~RESTRAINED~~	~~PRESSURE CLASS 350~~	~~FLANGED~~	~~CLASS 53~~	~~NO~~				
PW	POTABLE WATER	**< 4" COPPER (Water service to hose bibbs)**	**SOLDERED**	**TYPE K**	**SOLDERED**	**TYPE K**	**NO**	100	125	150	150
		< 4" PVC / CPVC[3]	SOCKET	SCH 80	SOCKET/ FLANGED	SCH 80	NO				
		>=4" PVC (replace in kind)	DI MJ RESTRAINED	C900 PC235 DR18	NOT APPLICABLE	NOT APPLICABLE	NO				
		> = 4" DIP (replace in kind)	DI MJ RESTRAINED	PRESSURE CLASS 350	FLANGED	CLASS 53	NO				
SPD	SUMP PUMP DISCHARGE	< 4" PVC / CPVC[3]	SOCKET	SCH 80	SOCKET/ FLANGED	SCH 80	NO	30	40	50	50

1) Surge pressure is the maximum pressure in the system during a surge event. Restraint pressure shall be used to determine pipe joint design and if required, the size, number, material, and dimensions of tabs and threaded-rods and thrust blocking for thrust restraint of piping and piping system components specified.
2) Provide heat tracing and insulation as specified in Section 40 41 13 on all exposed outdoor piping indicated.
3) For all PVC / CPVC designations, for this project CPVC shall be used unless PVC is specifically called out on the Drawings.
4) Flanges shall be provided as shown on the drawings or as approved by the Engineer.
5) Gravity pipe pressure test to utilize air at not greater than 5 psi.

CHEMICAL PIPING SCHEDULE

PIPE DESIGNATIONS		MATERIAL	BURIED PIPING		EXPOSED PIPING			DESIGN PRESSURE (PSI)[1]		
			TYPE OF JOINT	CLASS/ DESIGN	TYPE OF JOINT	CLASS/ DESIGN	HEAT TRACE[2]	WORKING	RESTRAINT	FIELD TEST
CLS	CHLORINE SOLUTION	< 4" PVC / CPVC[3]	SOCKET	SCH 80	SOCKET/ FLANGED	SCH 80	NO	100	150	150
		PVC HOSE (IN CCP)	COMPRESSION	SECTION 40 05 31	N/A	N/A	NO			
CCP	CHEMICAL CASING PIPE	< 4" PVC / CPVC[3]	SOCKET	SCH 40 (LONG RADIUS BENDS)	SOCKET/ FLANGED	SCH 40 (LONG RADIUS BENDS)	NO	N/A	N/A	10
SH	SODIUM HYPHOCHLORITE	< 4" PVC / CPVC[3]	SOCKET	SCH 80	SOCKET/ FLANGED	SCH 80	NO	100	120	150
		HDPE	FUSION	SDR 11	N/A	N/A	NO			
		PVC HOSE (IN CCP)	COMPRESSION	SECTION 40 05 31	N/A	N/A	NO			

1) Surge pressure is the maximum pressure in the system during a surge event. Restraint pressure shall be used to determine pipe joint design and if required, the size, number, material, and dimensions of tabs and threaded-rods and thrust blocking for thrust restraint of piping and piping system components specified.
2) Provide heat tracing and insulation as specified in Section 40 41 13 on all exposed outdoor piping indicated.
3) For all PVC / CPVC designations, for this project CPVC shall be used unless PVC is specifically called out on the Drawings.
4) Flanges shall be provided as shown on the drawings or as approved by the Engineer.

END OF SECTION

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TABLE 40 61 91A
INSTRUMENT SCHEDULE

TAG No.	SERVICE DESCRIPTION	STATE/SPAN	P&ID	REMARKS
SECTION - 40 72 23.01 - RADAR LEVEL METERS - Two Wire				
LT-65411	BULK STORAGE TANK No. 1 (TK-65411) - LEVEL SENSOR/TRANSMITTER	0 - 12.33 ft	I-03	
LT-65412	BULK STORAGE TANK No. 2 (TK-65412) - LEVEL SENSOR/TRANSMITTER	0 - 12.33 ft	I-03	
LT-65413	BULK STORAGE TANK No. 3 (TK-65413) - LEVEL SENSOR/TRANSMITTER	0 - 12.33 ft	I-03	
LT-65414	BULK STORAGE TANK No. 4 (TK-65414) - LEVEL SENSOR/TRANSMITTER	0 - 12.33 ft	I-03	
LT-65415	BULK STORAGE TANK No. 5 (TK-65415) - LEVEL SENSOR/TRANSMITTER	0 - 12.33 ft	I-03	
LT-65416	BULK STORAGE TANK No. 6 (TK-65416) - LEVEL SENSOR/TRANSMITTER	0 - 12.33 ft	I-03	
SECTION - 40 72 73 - SIGHT LEVEL GAUGES				
LG-65411	BULK STORAGE TANK No. 1 (TK-65411) - LEVEL GAUGE	0 - 12.33 ft	I-03	
LG-65412	BULK STORAGE TANK No. 2 (TK-65412) - LEVEL GAUGE	0 - 12.33 ft	I-03	
LG-65413	BULK STORAGE TANK No. 3 (TK-65413) - LEVEL GAUGE	0 - 12.33 ft	I-03	
LG-65414	BULK STORAGE TANK No. 4 (TK-65414) - LEVEL GAUGE	0 - 12.33 ft	I-03	
LG-65415	BULK STORAGE TANK No. 5 (TK-65415) - LEVEL GAUGE	0 - 12.33 ft	I-03	
LG-65416	BULK STORAGE TANK No. 6 (TK-65416) - LEVEL GAUGE	0 - 12.33 ft	I-03	
SECTION - 40 72 76.26 - LEVEL SWITCHES				
LSH-65410-A	CHEMICAL CONTAINMENT SUMP NO. 1 - HIGH LEVEL SWITCH	ON/OFF	I-03	
LSH-65410-B	CHEMICAL CONTAINMENT SUMP NO. 2 - HIGH LEVEL SWITCH	ON/OFF	I-03	
~~LSH-56016~~	~~REMOTE DOSIGN POINT SUMP NO. 1 - HIGH LEVEL SWITCH~~	~~ON/OFF~~	~~I-08~~	
~~LSH-56015~~	~~REMOTE DOSIGN POINT SUMP NO. 2 - HIGH LEVEL SWITCH~~	~~ON/OFF~~	~~I-08~~	
SECTION - 40 71 79.16 - FLOW SWITCHES (THERMAL)				
FSL-56001	TRANSFER PUMP (TP-56001) - LOW FLOW SWITCH (SUCTION SIDE)	ON/OFF	I-07	FIELD ADJUSTABLE

TAG No.	SERVICE DESCRIPTION	STATE/SPAN	P&ID	REMARKS
~~SECTION - 40 71 39 - PADDLE WHEEL INSERTION FLOWMETERS~~				
~~FI-56012~~	~~NON POTABLE WATER CCT FLOW INDICATION~~			~~BATTERY OPERATED~~
~~FI-56016~~	~~REUSE WATER CCT FLOW INDICATION~~			~~BATTERY OPERATED~~
~~FI-56015~~	~~OUTFALL DOSING STATION FLOW INDICATION~~			~~BATTERY OPERATED~~

TABLE 40 61 93A
INPUT/OUTPUT SCHEDULE

TAG	SERVICE DESCRIPTION	PLC	I/O TYPE	P&ID	NOTES
ANALOG INPUTS					
LI-65411	BULK STORAGE TANK No. 1 (TK-65411)-LEVEL	RIO-5 (PLC-4)	AI	I-03	
LI-65412	BULK STORAGE TANK No. 2 (TK-65412)-LEVEL	RIO-5 (PLC-4)	AI	I-03	
LI-65413	BULK STORAGE TANK No. 3 (TK-65413)-LEVEL	RIO-5 (PLC-4)	AI	I-03	
LI-65414	BULK STORAGE TANK No. 4 (TK-65414)-LEVEL	RIO-5 (PLC-4)	AI	I-03	
LI-65416	BULK STORAGE TANK No. 6 (TK-65416)-LEVEL	RIO-5 (PLC-4)	AI	I-03	
LI-65415	BULK STORAGE TANK No. 5 (TK-65415)-LEVEL	RIO-5 (PLC-4)	AI	I-03	
SI-56616	CL2 CHAMBER REUSE SYST. METERING PUMP NO. 2 (MP-56616)-SPEED FEEDBACK	RIO-5 (PLC-4)	AI	I-04	
SI-56016	CL2 CHAMBER REUSE SYST. METERING PUMP NO. 1 (MP-56016)-SPEED FEEDBACK	RIO-5 (PLC-4)	AI	I-04	
SI-56613A	PRE-CL2 AT FILTERS REUSE SYST. METERING PUMP NO. 2 (MP-56613A)-SPEED FEEDBACK	RIO-5 (PLC-4)	AI	I-04	
SI-56013A	PRE-CL2 AT FILTERS REUSE SYST. METERING PUMP NO. 1 (MP-56013A)-SPEED FEEDBACK	RIO-5 (PLC-4)	AI	I-04	
SI-56612	CL2 CHAMBER NPW SYSTEM METERING PUMP NO. 2 (MP-56612)-SPEED FEEDBACK	RIO-5 (PLC-4)	AI	I-05	
SI-56012	CL2 CHAMBER NPW SYSTEM METERING PUMP NO. 1 (MP-56012)-SPEED FEEDBACK	RIO-5 (PLC-4)	AI	I-05	
SI-56013B	PRE-CL2 AT FILTERS NPW SYST. METERING PUMP NO. 1 (MP-56013B)-SPEED FEEDBACK	RIO-5 (PLC-4)	AI	I-05	
SI-56613B	PRE-CL2 AT FILTERS REUSE SYST. METERING PUMP NO. 2 (MP-56613B)-SPEED FEEDBACK	RIO-5 (PLC-4)	AI	I-05	
SI-56010	HEADWORKS ODOR CONTROL METERING PUMP NO. 1 (MP-56010)-SPEED FEEDBACK	RIO-5 (PLC-4)	AI	I-06	
SI-56610	HEADWORKS ODOR CONTROL METERING PUMP NO. 2 (MP-56610)-SPEED FEEDBACK	RIO-5 (PLC-4)	AI	I-06	
SI-56015	EFFLUENT PUMP STATION METERING PUMP NO. 1 (MP-56015)-SPEED FEEDBACK	RIO-5 (PLC-4)	AI	I-06	
SI-56615	EFFLUENT PUMP STATION METERING PUMP NO. 2 (MP-56615)-SPEED FEEDBACK	RIO-5 (PLC-4)	AI	I-06	
SI-56009	RAS SYSTEM METERING PUMP (MP-56009)-SPEED FEEDBACK	RIO-5 (PLC-4)	AI	I-07	
SI-56011	INFLUENT PUMP STATION METERING PUMP (MP-56011)-SPEED FEEDBACK	RIO-5 (PLC-4)	AI	I-07	
ANALOG OUTPUTS					
SC-56016	CL2 CHAMBER REUSE SYST. METERING PUMP NO. 1 (MP-56016)-SPEED COMMAND	RIO-5 (PLC-4)	AO	I-04	
SC-56616	CL2 CHAMBER REUSE SYST. METERING PUMP NO. 2 (MP-56616)-SPEED COMMAND	RIO-5 (PLC-4)	AO	I-04	
SC-56013A	PRE-CL2 AT FILTERS REUSE SYST. METERING PUMP NO. 1 (MP-56013A)-SPEED COMMAND	RIO-5 (PLC-4)	AO	I-04	
SC-56613A	PRE-CL2 AT FILTERS REUSE SYST. METERING PUMP NO. 2 (MP-56613A)-SPEED COMMAND	RIO-5 (PLC-4)	AO	I-04	
SC-56012	CL2 CHAMBER NPW SYSTEM METERING PUMP NO. 1 (MP-56012)-SPEED COMMAND	RIO-5 (PLC-4)	AO	I-05	

TAG	SERVICE DESCRIPTION	PLC	I/O TYPE	P&ID	NOTES
SC-56612	CL2 CHAMBER NPW SYSTEM METERING PUMP NO. 2 (MP-56612)-SPEED COMMAND	RIO-5 (PLC-4)	AO	I-05	
SC-56013B	PRE-CHLORIN. AT FILTERS NPW SYST. METERING PUMP NO. 1 (MP-56013B)-SPEED COMMAND	RIO-5 (PLC-4)	AO	I-05	
SC-56613B	PRE-CHLORIN. AT FILTERS REUSE SYST. METERING PUMP NO. 2 (MP-56613B)-SPEED COMMAND	RIO-5 (PLC-4)	AO	I-05	
SC-56015	EFFLUENT PS METERING PUMP NO. 1 (MP-56015)-SPEED COMMAND	RIO-5 (PLC-4)	AO	I-06	
SC-56615	EFFLUENT PS METERING PUMP NO. 2 (MP-56615)-SPEED COMMAND	RIO-5 (PLC-4)	AO	I-06	
SC-56010	HEADWORKS ODOR CONTROL METERING PUMP NO. 1 (MP-56010)-SPEED COMMAND	RIO-5 (PLC-4)	AO	I-06	
SC-56610	HEADWORKS ODOR CONTROL METERING PUMP NO. 2 (MP-56610)-SPEED COMMAND	RIO-5 (PLC-4)	AO	I-06	
SC-56009	RAS SYSTEM METERING PUMP (MP-56009)-SPEED COMMAND	RIO-5 (PLC-4)	AO	I-07	
SC-56011	INFLUENT PS METERING PUMP (MP-56011)-SPEED COMMAND	RIO-5 (PLC-4)	AO	I-07	

DISCRETE INPUTS

LAHH-65410-A	CHEMICAL CONTAINMENT-LEVEL ALARM HIGH HIGH	RIO-5 (PLC-4)	DI	I-03	
LAHH-65410-B	CHEMICAL CONTAINMENT-LEVEL ALARM HIGH HIGH	RIO-5 (PLC-4)	DI	I-03	
YA-56016	CL2 CHAMBER REUSE SYST. METERING PUMP NO. 1 (MP-56016)-FAULT	RIO-5 (PLC-4)	DI	I-04	
YA-56616	CL2 CHAMBER REUSE SYST. METERING PUMP NO. 2 (MP-56616)-FAULT	RIO-5 (PLC-4)	DI	I-04	
YL-56616	CL2 CHAMBER REUSE SYST. METERING PUMP NO. 2 (MP-56616)-IN REMOTE	RIO-5 (PLC-4)	DI	I-04	
YL-56016	CL2 CHAMBER REUSE SYST. METERING PUMP NO. 1 (MP-56016)-IN REMOTE	RIO-5 (PLC-4)	DI	I-04	
YA-56613A	PRE-CL2 AT FILTERS REUSE SYST. METERING PUMP NO. 2 (MP-56613A)-FAULT	RIO-5 (PLC-4)	DI	I-04	
YA-56013A	PRE-CL2 AT FILTERS REUSE SYST. METERING PUMP NO. 1 (MP-56013A)-FAULT	RIO-5 (PLC-4)	DI	I-04	
YL-56013A	PRE-CL2 AT FILTERS REUSE SYST. METERING PUMP NO. 1 (MP-56013A)-IN REMOTE	RIO-5 (PLC-4)	DI	I-04	
YL-56613A	PRE-CL2 AT FILTERS REUSE SYST. METERING PUMP NO. 2 (MP-56613A)-IN REMOTE	RIO-5 (PLC-4)	DI	I-04	
YA-56012	CL2 CHAMBER NPW SYST. METERING PUMP NO. 1 (MP-56012)-FAULT	RIO-5 (PLC-4)	DI	I-05	
YA-56612	CL2 CHAMBER NPW SYST. METERING PUMP NO. 2 (MP-56612)-FAULT	RIO-5 (PLC-4)	DI	I-05	
YL-56012	CL2 CHAMBER NPW SYST. METERING PUMP NO. 1 (MP-56012)-IN REMOTE	RIO-5 (PLC-4)	DI	I-05	
YL-56612	CL2 CHAMBER NPW SYST. METERING PUMP NO. 2 (MP-56612)-IN REMOTE	RIO-5 (PLC-4)	DI	I-05	
YA-56013B	PRE-CL2 AT FILTERS NPW SYST. METERING PUMP NO. 1 (MP-56013B)-FAULT	RIO-5 (PLC-4)	DI	I-05	
YA-56613B	PRE-CL2 AT FILTERS NPW SYST. METERING PUMP NO. 2 (MP-56613B)-FAULT	RIO-5 (PLC-4)	DI	I-05	
YL-56013B	PRE-CL2 AT FILTERS NPW SYST. METERING PUMP NO. 1 (MP-56013B)-IN REMOTE	RIO-5 (PLC-4)	DI	I-05	
YL-56613B	PRE-CL2 AT FILTERS NPW SYST. METERING PUMP NO. 2 (MP-56613B)-IN REMOTE	RIO-5 (PLC-4)	DI	I-05	
YA-56010	HEADWORKS ODOR CONTROL METERING PUMP NO. 1 (MP-56010)-FAULT	RIO-5 (PLC-4)	DI	I-06	
YA-56610	HEADWORKS ODOR CONTROL METERING PUMP NO. 2 (MP-56610)-FAULT	RIO-5 (PLC-4)	DI	I-06	

TAG	SERVICE DESCRIPTION	PLC	I/O TYPE	P&ID	NOTES
YL-56010	HEADWORKS ODOR CONTROL METERING PUMP NO. 1 (MP-56010)-IN REMOTE	RIO-5 (PLC-4)	DI	I-06	
YL-56610	HEADWORKS ODOR CONTROL METERING PUMP NO. 2 (MP-56610)-IN REMOTE	RIO-5 (PLC-4)	DI	I-06	
YA-56015	EFFLUENT PUMP STATION METERING PUMP NO. 1 (MP-56015)-FAULT	RIO-5 (PLC-4)	DI	I-06	
YA-56615	EFFLUENT PUMP STATION METERING PUMP NO. 2 (MP-56615)-FAULT	RIO-5 (PLC-4)	DI	I-06	
YL-56015	EFFLUENT PUMP STATION METERING PUMP NO. 1 (MP-56015)-IN REMOTE	RIO-5 (PLC-4)	DI	I-06	
YL-56615	EFFLUENT PUMP STATION METERING PUMP NO. 2 (MP-56615)-IN REMOTE	RIO-5 (PLC-4)	DI	I-06	
YA-56009	RAS SYSTEM METERING PUMP (MP-56009)-FAULT	RIO-5 (PLC-4)	DI	I-07	
YL-56009	RAS SYSTEM METERING PUMP (MP-56009)-IN REMOTE	RIO-5 (PLC-4)	DI	I-07	
YX-56009	RAS SYSTEM METERING PUMP (MP-56009)-READY	RIO-5 (PLC-4)	DI	I-07	
YA-56011	INFLUENT PUMP STATION METERING PUMP (MP-56011)-FAULT	RIO-5 (PLC-4)	DI	I-07	
YL-56011	INFLUENT PUMP STATION METERING PUMP (MP-56011)-IN REMOTE	RIO-5 (PLC-4)	DI	I-07	
YL-56001	CL2 TRANSFER PUMP (TP-56001)-IN REMOTE	RIO-5 (PLC-4)	DI	I-07	
YLR-56001	CL2 TRANSFER PUMP (TP-56001)-RUNNING	RIO-5 (PLC-4)	DI	I-07	
YA-56001	CL2 TRANSFER PUMP (TP-56001)-OVERLOAD FAULT	RIO-5 (PLC-4)	DI	I-07	
FAL-56001	CL2 TRANSFER PUMP (TP-56001)-LOW FLOW ALARM	RIO-5 (PLC-4)	DI	I-07	
FAH-65421	EYE WASH SHOWER NO. 1-HIGH FLOW ALARM	RIO-5 (PLC-4)	DI	I-08	
FAH-65422	EYE WASH SHOWER NO. 2-HIGH FLOW ALARM	RIO-5 (PLC-4)	DI	I-08	
FAH-65423	EYE WASH SHOWER NO. 3-HIGH FLOW ALARM	RIO-5 (PLC-4)	DI	I-08	
FAH-65424	EYE WASH SHOWER NO. 4-HIGH FLOW ALARM	RIO-5 (PLC-4)	DI	I-08	
FAH-65425	EYE WASH SHOWER NO. 5-HIGH FLOW ALARM	RIO-5 (PLC-4)	DI	I-08	
~~LAH-56016~~	~~REMOTE DOSING POINT SUMP NO. 1-HIGH LEVEL ALARM~~	~~RIO-5 (PLC-4)~~	~~DI~~	~~I-08~~	
~~LAH-56015~~	~~REMOTE DOSING POINT SUMP NO. 2-HIGH LEVEL ALARM~~	~~RIO-5 (PLC-4)~~	~~DI~~	~~I-08~~	

DISCRETE OUTPUTS

LAH-65411	BULK STORAGE TANK No. 1 (TK-65411)-MAX. FILL LEVEL	RIO-5 (PLC-4)	DO	I-03	
LAH-65412	BULK STORAGE TANK No. 2 (TK-65412)-MAX. FILL LEVEL	RIO-5 (PLC-4)	DO	I-03	
LAH-65413	BULK STORAGE TANK No. 3 (TK-65413)-MAX. FILL LEVEL	RIO-5 (PLC-4)	DO	I-03	
LAH-65414	BULK STORAGE TANK No. 4 (TK-65414)-MAX. FILL LEVEL	RIO-5 (PLC-4)	DO	I-03	
LAH-65415	BULK STORAGE TANK No. 5 (TK-65415)-MAX. FILL LEVEL	RIO-5 (PLC-4)	DO	I-03	
LAH-65416	BULK STORAGE TANK No. 6 (TK-65416)-MAX. FILL LEVEL	RIO-5 (PLC-4)	DO	I-03	
LAHH-65411	BULK STORAGE TANK No. 1 (TK-65411)-HIGH HIGH LEVEL ALARM	RIO-5 (PLC-4)	DO	I-03	

TAG	SERVICE DESCRIPTION	PLC	I/O TYPE	P&ID	NOTES
LAHH-65412	BULK STORAGE TANK No. 2 (TK-65412)-HIGH HIGH LEVEL ALARM	RIO-5 (PLC-4)	DO	I-03	
LAHH-65413	BULK STORAGE TANK No. 3 (TK-65413)-HIGH HIGH LEVEL ALARM	RIO-5 (PLC-4)	DO	I-03	
LAHH-65414	BULK STORAGE TANK No. 4 (TK-65414)-HIGH HIGH LEVEL ALARM	RIO-5 (PLC-4)	DO	I-03	
LAHH-65415	BULK STORAGE TANK No. 5 (TK-65415)-HIGH HIGH LEVEL ALARM	RIO-5 (PLC-4)	DO	I-03	
LAHH-65416	BULK STORAGE TANK No. 6 (TK-65416)-HIGH HIGH LEVEL ALARM	RIO-5 (PLC-4)	DO	I-03	
YCR-56016	CL2 CHAMBER REUSE SYST. METERING PUMP NO. 1 (MP-56016)-RUN CMD	RIO-5 (PLC-4)	DO	I-04	
YCR-56616	CL2 CHAMBER REUSE SYST. METERING PUMP NO. 2 (MP-56616)-RUN CMD	RIO-5 (PLC-4)	DO	I-04	
YCR-56613A	PRE-CL2 AT FILTERS REUSE SYST. METERING PUMP NO. 2 (MP-56613A)-RUN CMD	RIO-5 (PLC-4)	DO	I-04	
YCR-56013A	PRE-CL2 AT FILTERS REUSE SYST. METERING PUMP NO. 1 (MP-56013A)-RUN CMD	RIO-5 (PLC-4)	DO	I-04	
YCR-56012	CL2 CHAMBER NPW SYST METERING PUMP NO. 1 (MP-56012)-RUN CMD	RIO-5 (PLC-4)	DO	I-05	
YCR-56612	CL2 CHAMBER NPW SYST METERING PUMP NO. 2 (MP-56612)-RUN CMD	RIO-5 (PLC-4)	DO	I-05	
YCR-56013B	PRE-CL2 AT FILTERS NPW SYST. METERING PUMP NO. 1 (MP-56013B)-RUN CMD	RIO-5 (PLC-4)	DO	I-05	
YCR-56613B	PRE-CL2 AT FILTERS NPW SYST. METERING PUMP NO. 2 (MP-56613B)-RUN CMD	RIO-5 (PLC-4)	DO	I-05	
YCR-56010	HEADWORKS ODOR CONTROL METERING PUMP NO. 1 (MP-56010)-RUN CMD	RIO-5 (PLC-4)	DO	I-06	
YCR-56610	HEADWORKS ODOR CONTROL METERING PUMP NO. 2 (MP-56610)-RUN CMD	RIO-5 (PLC-4)	DO	I-06	
YCR-56015	EFFLUENT PUMP STATION METERING PUMP NO. 1 (MP-56015)-RUN CMD	RIO-5 (PLC-4)	DO	I-06	
YCR-56615	EFFLUENT PUMP STATION METERING PUMP NO. 2 (MP-56615)-RUN CMD	RIO-5 (PLC-4)	DO	I-06	
YCR-56009	RAS SYSTEM METERING PUMP (MP-56009)-RUN CMD	RIO-5 (PLC-4)	DO	I-07	
YCR-56011	INFLUENT PS METERING PUMP (MP-56011)-RUN CMD	RIO-5 (PLC-4)	DO	I-07	
YCR-56001	TRANSFER PUMP (TP-56001)-START/STOP	RIO-5 (PLC-4)	DO	I-07	
XC-56001	TRANSFER PUMP (TP-56001)-ENABLE LOCAL TRANSFER	RIO-5 (PLC-4)	DO	I-07	

SECTION 40 61 96
PROCESS CONTROL DESCRIPTIONS

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish, test, install and place in satisfactory operation all equipment as herein specified and as shown on the Drawings. THE CONTRACTOR SHALL BE RESPONSIBLE FOR FURNISHING COMPLETE FUNCTIONING SYSTEMS AS DESCRIBED HEREIN.

B. Together with the control system input/output schedule, the equipment specifications (including process control descriptions for local equipment control panels), and the Drawings, the process control descriptions describe the required operation, monitoring, and control of the facilities included in this Contract.

C. THE PROCESS CONTROL DESCRIPTIONS CONTAIN REQUIREMENTS FOR FURNISHING AND INSTALLING LABOR AND MATERIALS THAT MAY NOT APPEAR ELSEWHERE IN THE CONTRACT DOCUMENTS.

D. All equipment and services required in equipment local control panels provided to implement the monitoring and control functions described herein or in the process input/output schedules shall be provided by the Contractor through individual equipment suppliers.

E. Unless specifically stated otherwise, all interconnected wiring between all instruments, panels, controls, and other devices listed in the process control descriptions as required to provide all functions specified herein shall be furnished by the electrical subcontractor under Division 26. The electrical subcontractor shall provide all cable and conduit required to carry all signals listed in the process input/output schedules. Special cables that are required for interconnection between sensors or probes and transmitters or signal conditioners shall be furnished with the instrumentation devices by the equipment supplier.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01 14 00 – Coordination with Owner's Operations

B. Section 40 61 91 – Process Control System Instrument List

C. Section 40 61 93 – Process Control System Input/Output List

D. Section 46 33 42 – Mechanical Diaphragm Metering Pumps

PART 2 – PROCESS CONTROL DESCRIPTIONS, GENERAL

2.01 DEFINITIONS

A. RUNNING status signals shall be from auxiliary contacts provided with the motor control equipment (i.e., starter, VFD, SCR, etc.).

B. AUTO status signals shall be defined as HAND-OFF-AUTO switch in the AUTO position or process control system in AUTO (versus MANUAL).

C. FAIL status signals shall be defined as motor overload and/or any other shut down mode such as overtorque, overtemperature, low oil pressure, high vibration, etc.

D. READY status signal shall be defined as all conditions, including equipment control power, satisfied to permit remote control of the equipment.

2.02 CONVENTIONS

A. Indicator lights on all MCC's, control panels, starter enclosures, etc. shall conform to the following color convention:

Condition	Color
Running/On/Open	Red
Stopped/Off/Closed	Green
Fault/Alarm	Amber

B. Operator workstation HMI graphic display symbols shall conform to the following color convention:

Condition	Color
Graphic background	Light grey
Running/On/Open	Soft white
Stopped/Off/Closed (in local)	Light grey; black outline (shape)
Stopped/Off/Closed (remote manual)	Blue
Stopped/Off/Closed (remote auto)	Medium grey
Fault/Alarm	Amber
Generic Status	Blue

2.03 PROCESS CONTROL

A. Where setpoints, operating limits, and other control settings are provided by the functional descriptions, these settings shall be initial settings only and shall be used for assistance in the initial startup of the plant. All such settings shall be fully adjustable and, based on actual operating conditions, the instrumentation subcontractor shall make all necessary adjustments to provide smooth, stable operation at no additional cost to the Owner.

B. Provision shall be made in PLC logic to suppress nuisance alarms and control actions by the following means:

1. For analog inputs digital filters shall be used to smooth time varying analog input data in accordance with the equation given below. The filter time constant shall be a function of the sampling period and the digital filtering constant, both of which shall be operator adjustable (password protected).

   The filter calculation shall be executed every 300ms as a starting point. Test and adjust digital filters during commissioning and fine tune as required by the process

2. For alarms and control actions derived from analog input signals, use adjustable time delays and deadbands.

3. For alarms and control actions derived from discrete input signals, use adjustable time delays.

4. Initial settings for time delays shall be 10 seconds (range 0-120 seconds). Initial settings for deadbands shall be 5% of span (range 0-100%).

5. Equipment that is started or stopped manually by the operator shall start or stop immediately, with no time delay.

C. All setpoint control shall be by PID control algorithms. Where only proportional control is specified, tuning constants shall be used to reduce the Integral and Derivative functions to zero. All setpoints, sequence times, sequence orders, dead bands, PID tuning parameters, PLC delay timers, variable speed operating range limits, and similar control constants shall be accessible and alterable from the operator workstations.

D. Unless otherwise specified, all equipment shall automatically restart after a power failure utilizing adjustable start delay timers in PLC control logic. Unless otherwise specified, all PLC control strategies shall be based upon automatic restart after a power failure and shall return to a normal control mode upon restoration of power.

E. The PLC shall be capable of receiving initial run-time values for existing and proposed equipment. Initial run-time shall not automatically be assumed to be zero.

F. A control discrepancy alarm shall be generated through the PLC for any drive, motor, etc. for which a command has been issued, but for which the PLC is not receiving a confirming status signal (e.g., start command with no run feedback). The failure shall be logged.

G. An instrument failure alarm shall be generated for any instrument which is generating a signal that is less than 4 mA or greater than 20 mA.

H. Unless otherwise specified in an individual control description, an instrument failure or control discrepancy alarm shall cause the control strategy to maintain last values and to generate an alarm. Manual initiation of the automatic control strategy shall be required.

I. A control program that controls multiple pieces of equipment shall not be prevented from running because not all of the equipment is in AUTO. If equipment within an equipment chain is required to be running for program operation and it is running in HAND or MANUAL, then the program shall run and control the other equipment that is in AUTO.

J. All PLC wait states (internal time delays, etc.) after an operator action shall be displayed on the operator workstation.

K. When switching from Auto to Manual, controlled equipment shall remain in its current state (e.g., running, stopped, speed, position, etc.). Likewise, when switching from Manual to Automatic, the equipment shall initially be in the current state until the Automatic control strategy requires a change.

PART 3 – PROCESS CONTROL DESCRIPTIONS

3.01 OVERVIEW

A. The Temporary Sodium Hypochlorite System at the City of Hollywood Wastewater Treatment Plant consists of six (6) bulk storage tanks designed to store Sodium Hypochlorite for controlled chemical dosing. The system supplies Sodium Hypochlorite to eight (8) dedicated metering pump skids. Each skid is responsible for delivering a controlled dose of Sodium Hypochlorite to specific injection points within the plant's treatment process.

B. The temporary system is controlled by a newly installed control panel, designated “PLC-4 RIO RACK 5”, equipped a Remote IO (RIO-5) drop connected via fiber to the existing PLC-4 M580. Existing PLC-4 shall manage the dosing control strategy by adjusting dosing rates based on operational requirements and real-time feedback conditions.

C. The control panel communicates with the plant's existing SCADA system via fiber optic communication, enabling real-time monitoring, remote adjustments, and comprehensive performance oversight. Existing SCADA screens will be modified to incorporate the new control and monitoring functions specific to the temporary dosing system.

D. The existing chemical system PLC logic will remain operational until the new system is fully integrated into the SCADA HMI system and declared fully functional.

3.02 SYSTEM AVAILABILITY

A. The Contractor, through the services of the instrumentation and control system subcontractor, shall develop a plan for each phase of the migration from the existing to the new system with respect to the PLC and the SCADA HMI screens development.

B. Fully automatic, continuous operation of the chemical feed systems from the SCADA HMI is required for the duration of the project. Therefore, individual existing chemical systems shall only be taken out of service once the new temporary chemical system has been fully tested and determined to be ready for fully automatic operation from the SCADA HMI.

C. Any exceptions to this requirement must be pre-approved by both the Engineer and City.

3.03 METERING PUMP AUTOMATIC CONTROL STRATEGIES

A. Feed Forward: Ratio Control

The automatic control strategy shall modulate the duty metering pump on each skid to maintain an adjustable ratio setpoint of the chemical (ppm) to the flow to be treated (MGD). The flow required from a feed pump shall be calculated with the following formula:

$$\text{Flow Required (gph)} = \frac{\text{Dosage (ppm)} * \text{Process Flow (MGD)} * 41640(\text{gph/MGD})}{\text{Chemical concentration (ppm)} * \text{Specific Gravity}} \quad (1)$$

Where:

Flow Required: Calculated flow required from the feed metering pump.

Dosage: Amount of chemical in parts per million (ppm) that treated water flow must contain.

Process Flow: Treated water flow, this value depends on the RO skids running or raw water supply.

Chemical Concentration: Specific value for each chemical.

Specific Gravity: Specific value for each chemical.

Example:

Dosage = 2 ppm
Process Flow = 2 MGD
Chemical concentration = 125,000 ppm (12.5%) (assuming specific gravity = 1)
Flow Required = 1.33 gph

If in the example we are using a metering pump with range of 0 – 6.9 gph (linear with speed), the 1.33 gph flow required equates to a speed of 19.28%.

B. Feedback Control

Feedback involves measuring the output of a process and comparing it to a desired setpoint. The feedback PID controller shall maintain a constant residual at a pre-set value (operator setpoint). The feedback PID controller output shall adjust the setpoint of the ratio controller which combines the feedforward and feedback loops. There shall be two selectable options for trim feedback.

1. Trim Mode 1: Fixed incremental trim value, initially set at ± 0.1 ppm. Repeat after an adjustable set duration, initially set at 2 minutes.

   Example:

   In remote automatic mode, the duty pump output will be modulated to maintain a ratio of Sodium Hypochlorite to the flow at the Effluent Pump Station Wetwell. With chlorine residual feedback trim enabled and set to “Trim Mode 1 - Fixed”, the chlorine analyzer feedback indicates that the chlorine residual at the effluent is 0.60 ppm, which is below the 0.80 ppm set-point and outside of an adjustable ±0.05 ppm deadband. The Sodium Hypochlorite ratio target set-point shall be incrementally

increased 0.1 ppm every 2 minutes until the chlorine residual feedback indicates that the value is between 0.75 ppm and 0.85 ppm.

2. Trim Mode 2: The proportional trim value will increase or decrease the ratio setpoint on the magnitude of difference between the target setpoint and the measured value, the resulting calculation is also referred to as the error "e". Proportional trim shall function in the same manner as the Trim Mode 1 example above, except the increment value shall be proportional to the error times the gain. The amount of change in the target chemical setpoint output shall be determined by the following equation:

$$\Delta \mathrm{SP} = \mathrm{G} * (\mathrm{SP} - \mathrm{PV}) = \mathrm{G} * \mathrm{e}$$

Where:

$\Delta \mathrm{PS}$: Change target setpoint output required.

G: Gain (operator adjustable).

SP: Setpoint (Operator adjustable).

PV: Process Variable.

e: Error.

Example:

In remote automatic mode, the duty pump output will be modulated to maintain a ratio of Sodium Hypochlorite to the flow at the Effluent Pump Station Wetwell. With chlorine residual feedback trim enabled and set to "Trim Mode 2 – Proportional" and a target chlorine residual of 2.5 ppm, starting with a ratio setpoint of 3 ppm, the feedback indicates a chlorine residual of 2.0 ppm, which is outside the ±0.1 ppm deadband.

The error is:

e = SP - PV = 2.5 – 2.0 = +0.50

With the gain "G" set at 0.3, the proportional response is:

ΔSP = 0.3 x 0.50 = +0.15

The +0.15 ΔSP is applied to the ratio setpoint, 3.0 + 0.15 = 3.15 ppm, resulting in a new ratio setpoint of 3.15 ppm. The logic will execute again after an operator's adjustable time delay initially set at 2 minutes. During the next iteration, the error is determined to be +0.30 ppm which is outside the deadband, so the trim is applied:

ΔSP = 0.3 x 0.3 = +0.09

The +0.09 ΔSP is applied to the ratio setpoint, 3.15 + 0.09 = 3.24 ppm, resulting in a new ratio setpoint of 3.24 ppm. After 2 minutes the logic is executed again, and the error is determined to be +0.05 ppm which is inside the deadband, so no action is taken for 2 minutes.

In general, the ratio value shall be limited to minimize overfeed or underfeed in the event of chlorine analyzer malfunction. In addition, the operator shall have the option of disabling the trim modes mentioned above to limit the control output to ratio control only.

3.04 CONTROL STRATEGIES INDEX

Section	Description
3.05	Sodium Hypochlorite Storage System
3.06	Sodium Hypochlorite Transfer System
3.07	Sodium Hypochlorite Feed System

3.05 SODIUM HYPOCHLORITE STORAGE SYSTEM

Drawings: I-03

A. Process Overview

1. The system consists of six (6) bulk storage tanks within a dedicated chemical containment area, designed to store Sodium Hypochlorite before dosing to the injection points throughout the plant.

2. Bulk storage tanks TK-65411, TK-65413 and TK-65415 are controlled by the East Sodium Hypochlorite Unloading Local Alarm Panel (LAP-65421). Bulk storage tanks TK-65412, TK-65414 and TK-65416 are controlled by the West Sodium Hypochlorite Unloading Local Alarm Panel (LAP-65422). The control panels transmit signals via hardwired cables to the “PLC-4 RIO RACK 5” control panel, which is equipped with RIO-5, an Ethernet Remote I/O drop connected to the existing PLC-4. PLC-4 communicates with the plant's SCADA system enabling real-time monitoring and control of the Sodium Hypochlorite dosing system from the central SCADA interface.

3. Leak sensors, LSH-65410-A and LSH-65410-B, are installed in two sumps within the containment area to monitor chemical leaks. If a leak is detected, an alarm will be triggered and sent to the SCADA system via the Sodium Hypochlorite Containment Alarm Panel CAP-65410.

B. Control Operation

1. Each bulk storage tank is equipped with a reverse float sight gauge to indicate level and a radar sensor level transmitter. The level transmitter provides analog output to the Unloading Local Alarm Panel for indication of level, via an electronic indicator, as specified in Section 40 78 00 – Panel Mounted Instruments, that receives and displays the 4-20mA radar level signal. The panel is also equipped with pilot lights to indicate maximum fill level and high-high level alarm.

    a. Maximum fill level shall be a relay output, received by the Unloading Local Alarm Panel, from PLC-4 that is setpoint adjustable from SCADA. When maximum fill level condition is reached, control logic in the panel shall energize a panel mounted horn. Once the “reset” pushbutton has been pressed the horn shall deactivate.

    b. High-high level alarm shall be a relay output, received by the Unloading Local Alarm Panel, from PLC-4 that is setpoint adjustable from SCADA. High-high level setpoint shall be set above the maximum fill level setpoint. When high-high level condition is reached, control logic in the panel shall energize a panel mounted horn. Once the “reset” pushbutton has been pressed the horn shall deactivate. The pilot light shall remain

2. A sliding type float level switches, LSH-65410-A & LSH-65410-B, provides discrete output to the Sodium Hypochlorite Containment Alarm Panel, LAP-65410, when sump high level is detected in the chemical containment area. If the level switch detects a high level condition, control logic in the panel shall energize a panel-mounted horn and strobe local alarm and send alarm signals to SCADA. Once the high level condition is no longer present and the “reset” pushbutton has been pressed the horn and flashing light shall deactivate and alarm shall be reset. If the high level condition is still active and the “reset” pushbutton is pressed, the horn shall deactivate, the flashing light shall remain active and alarm shall remain latched.

C. Bulk Storage Tank Enable/Disable Feature

1. The SCADA system shall provide a screen-based functionality to enable or disable each individual bulk storage tank. This enable/disable status shall be configurable via the SCADA HMI and shall define which tanks are active for control strategy purposes.

2. Low level and high-high level alarm evaluation by PLC-4 shall only consider bulk tanks currently enabled through SCADA.

3. Storage tank enable/disable status shall be clearly indicated on the SCADA HMI.

D. Bulk Storage Tank Drain Rate Monitoring

1. PLC-4 shall continuously monitor the chemical drain rate in the bulk tanks installed under this contract via radar level transmitters. The PLC logic utilizes rate-of-change

(derivative) type calculations for determining the drain rate of each tank and compare the calculated rate with SCADA adjustable alarm set-points.

2. There shall be two configurable drain rate set-points for each chemical bulk storage tank: one for when no metering pumps are operating (static condition), and one for when one or more metering pumps are actively dosing (dynamic condition). The PLC logic shall automatically apply the appropriate set-point based on the operating status of the metering pumps. A critical alarm popup shall be displayed on the SCADA HMI if the measured drain rate exceeds the active set-point for more than 15 seconds: “Bulk Storage Tank High Drain Rate!”.

3. The drain rate alarm logic shall be disabled for any tank currently involved in a transfer operation (i.e., being drained into another tank), as such tank shall be marked as disabled in the system during the transfer.

4. Tank drain rate set-point values shall be coordinated with Engineer prior to the chemical feed system startup period during the independent radar testing sequence. The alarms shall be tested by filling and emptying bulk tanks with water to simulate a leak and shall be witnessed by Engineer.

3.06 SODIUM HYPOCHLORITE TRANSFER SYSTEM

Drawings: I-07 and I-11

A. Process Overview

1. The transfer system allows for the transfer of sodium hypochlorite from one bulk storage tank to another via the transfer pump TP-56001. The transfer process is manually configured by plant operators using the installed manual isolation valves. Before initiating a transfer, operators must manually select the source and destination tanks by positioning the appropriate isolation valves.

2. The system includes a dedicated Sodium Hypochlorite Transfer Local Control Panel LCP-56001, which provides status indication and control for the transfer pump.

B. Control Operation

1. Local controls

When the Hand-Off-Remote (HOR) selector switch, located in LCP-56001, is in the “Hand” position, a local call-to-run request for the transfer pump is issued. If an operator intends to initiate a local transfer using LCP-56001 in "Hand" mode, operations shall first notify SCADA to request authorization. SCADA shall issue an enable signal, implemented as a discrete output from PLC-4 to LCP-56001. The transfer pump shall only operate in "Hand" mode if this enable signal is received. If the enable signal is not received, the pump shall remain off even if the selector

switch is placed in the "Hand" position. When the selector switch is in the “Off” position, the transfer pump shall stop.

2. Remote Controls

When the Hand-Off-Remote selector switch, located in LCP-56001, is in “Remote” position, the transfer pump shall be controlled by PLC-4 logic. The operator shall be able to start/stop the pump via the SCADA screen. However, issuing a start command from SCADA shall not cause the pump to operate until the PLC generates the enable signal based on proper tank selection.

3. Common Enable Logic for Local and Remote Start Requests

Regardless of whether the start request originates from local mode (via HOR switch in “Hand”) or from remote mode (via SCADA system), the PLC shall issue an enable signal prior to allowing the pump to operate. A new dedicated SCADA screen shall be provided to allow the operator to select the source tank(s) and destination tank(s) involved in the transfer. Based on this selection, the PLC shall evaluate level conditions in the specified tanks. Once tank selections are made, the operator shall press the “*Enable Transfer*” button on the SCADA screen. This action will cause the PLC to activate a discrete digital output, issuing the enable signal required to permit pump operation. After the pump stops, the enable signal shall reset automatically, requiring the operator to re-select tanks and re-enable the transfer for each new pump transfer cycle.

4. Software Interlocks

The PLC shall continuously monitor stop conditions based on the selected tanks, including:

a. Maximum fill level or high-high level alarm in any of the destination tanks.

b. Low-low level alarm in any of the source tanks.

c. Flow not detected by low flow switch FSL-56001 while the pump is running.

3.07 SODIUM HYPOCHLORITE FEED SYSTEM

Drawings: I-04, I-05, I-06 and I-07.

A. Process Overview

1. The Sodium Hypochlorite Feed System consists of eight (8) metering pump skids. Each metering pump skid is controlled by a dedicated local control panel. The local control panels transmit control signals via hardwired connections to the temporary system control panel PLC-4 RIO RACK 5. Each skid is responsible for delivering a controlled dose of Sodium Hypochlorite to specific injection points throughout the

plant. The table 3.07A summarizes the injection points, configuration type, and reference drawing for each skid:

Table 3.07A – Sodium Hypochlorite Feed Systems

Injection Point	Configuration	Control panel	Drawing
Chlorine Contact Chamber Reuse system	Duplex	LCP-56016	I-04
Pre-chlorination at Filters Reuse system	Duplex	LCP-56013A	I-04
Chlorine Contact Chamber Non-potable water system	Duplex	LCP-56012	I-05
Pre-chlorination at Filters Non-potable water system	Duplex	LCP-56013B	I-05
Headworks Odor Control System	Duplex	LCP-56010	I-06
Effluent Pump Station	Duplex	LCP-56615	I-06
RAS Pump Station	Simplex	LCP-56009	I-07
Influent Pump station	Simplex	LCP-56011	I-07

B. Control Operations

1. Local Controls

Each metering pump skid is equipped with a dedicated local control panel as listed in Table 3.07A, that allows for independent operation and monitoring. When a pump's Local-Off-Remote selector switch is set to "Local" position, the pump speed shall be controlled locally by the operator from the control panel keypad.

~~For the Effluent Pump Station metering pump skid, a Local Control Station (LCS-56615) shall be provided by the metering pump skid manufacturer and installed near the dosing point. The LCS shall be equipped with two (2) Local-Off-Remote (LOR) switches, one for each pump, to enable local operation. Refer to Drawing I-06.~~

2. Remote Manual Controls

When a pump's Local-Off-Remote selector switch is set to "Remote" position, the pump speed shall be controlled by PLC-4. The operator shall be able to select automatic or manual mode on the SCADA screen. The transition between automatic and manual mode shall be bumpless. In manual mode, the operator is to start, stop and control the speed of the pump from the SCADA screen. This remote manual operation applies to all eight (8) dosification systems with the following exception:

Headworks Odor Control system – Special Manual Mode

In addition to standard Remote Manual control, the Headworks Odor Control System shall also provide four (4) predefined dosing rate modes. These preset modes shall be selectable by the operator via the SCADA HMI and shall define specific dosing speeds as shown in Table 3.07B. These preset dosing rates shall be the default mode, as no H_2S or ORP feedback control is included in the current system design.

Table 3.07B – Preset Dosing Rates

Dosing rate	Flow	Expected H_2S Concentration
Low	9 gph	5 ppmv
Medium	18 gph	10 ppmv
High	45 gph	25 ppmv
Max.	90 gph	50 ppmv

3. Remote Auto Controls

In auto mode, each metering pump skid operates under an automatic control strategy based on the specific requirements of each injection point. The control strategy is managed by the PLC-4 logic.

a. Chlorine Contact Chamber – Reuse system

Ratio Control

The feed automatic control logic shall calculate the flow required to maintain a ratio of sodium hypochlorite to reuse water flow by using equation (1) in Section 3.03 above. The calculated “flow required” value shall be used by the PLC logic to modulate the duty metering pump speed to maintain a setpoint adjustable ratio. The “flow required” value shall be calculated based on:

1) Dosage: Amount of sodium hypochlorite in ppm (parts per million) required to treat the reuse water flow. This value shall be coordinated with the Owner and the Engineer during startup.

2) Process Flow: Total reuse water flow (MGD).

3) Chemical concentration: The concentration (ppm) of the sodium hypochlorite solution being used.

4) Specific gravity: The specific gravity of the Sodium Hypochlorite solution.

Feedback Control

PLC automatic control strategy shall incorporate a sodium hypochlorite trim to enhance the flow rate control. It shall be possible to enable/disable this feature from the SCADA. The trim logic will only execute if the ratio setpoint falls

outside of an adjustable deadband and shall be executed based on a SCADA adjustable duration that continuously repeats. There shall be two selectable options for sodium hypochlorite trim that were explained in Section 3.03-B above. PLC logic shall use the influent chlorine residual signal from the low saline chlorine contact chamber to trim the dosing setpoint.

Software Interlocks

PLC logic shall prevent the metering pump from starting if any of the following conditions are met. This applies to both remote manual and remote automatic modes.

1) All bulk storage tanks currently enabled via SCADA are simultaneously in low level alarm condition.

2) Reuse water flow signal lost or out of range.

3) Influent chlorine residual signal lost or out of range.

b. Pre-chlorination at Filters – Reuse system

Ratio Control

The feed automatic control logic shall calculate the flow required to maintain a ratio of sodium hypochlorite to flow from low saline filter feed pumps by using equation (1) in Section 3.03 above. The calculated “flow required” value shall be used by the PLC logic to modulate the duty metering pump speed to maintain a setpoint adjustable ratio. The “flow required” value shall be calculated based on:

1) Dosage: Amount of sodium hypochlorite in ppm (parts per million) required to treat the flow from low saline filter feed pumps. This value shall be coordinated with the Owner and the Engineer during startup.

2) Process Flow: Flow from low saline filter feed pumps (MGD).

3) Chemical concentration: The concentration (ppm) of the sodium hypochlorite solution being used.

4) Specific gravity: The specific gravity of the Sodium Hypochlorite solution.

Software Interlocks

PLC logic shall prevent the metering pump from starting if any of the following conditions are met. This applies to both remote manual and remote automatic mode.

1) All bulk storage tanks currently enabled via SCADA are simultaneously in low level alarm condition.

2) Flow from low saline filter feed pumps signal lost or out of range.

c. Chlorine Contact Chamber – Non-potable water system

Ratio Control

The feed automatic control logic shall calculate the flow required to maintain a ratio of sodium hypochlorite to non-potable water (NPW) flow by using equation (1) in Section 3.03 above. The calculated “flow required” value shall be used by the PLC logic to modulate the duty metering pump speed to maintain a setpoint adjustable ratio. The “flow required” value shall be calculated based on:

1) Dosage: Amount of sodium hypochlorite in ppm (parts per million) required to treat the NPW flow. This value shall be coordinated with the Owner and the Engineer during startup.

2) Process Flow: Total NPW flow (MGD).

3) Chemical concentration: The concentration (ppm) of the sodium hypochlorite solution being used.

4) Specific gravity: The specific gravity of the Sodium Hypochlorite solution.

Feedback Control

PLC automatic control strategy shall incorporate a sodium hypochlorite trim to enhance the flow rate control. It shall be possible to enable/disable this feature from the SCADA. The trim logic will only execute if the ratio setpoint falls outside of an adjustable deadband and shall be executed based on a SCADA adjustable duration that continuously repeats. There shall be two selectable options for sodium hypochlorite trim that were explained in Section 3.03-B above. PLC logic shall use the influent chlorine residual signal from the saline chlorine contact chamber to trim the dosing setpoint.

Software Interlocks

PLC logic shall prevent the metering pump from starting if any of the following conditions are met. This applies to both remote manual and remote automatic mode.

1) All bulk storage tanks currently enabled via SCADA are simultaneously in low level alarm condition.

2) NPW flow signal lost or out of range.

3) Influent chlorine residual signal lost or out of range.

d. Pre-chlorination at Filters – Non-potable water system

Ratio Control

The feed automatic control logic shall calculate the flow required to maintain a ratio of sodium hypochlorite to flow from saline filter feed pumps by using equation (1) in Section 3.03 above. The calculated “flow required” value shall be used by the PLC logic to modulate the duty metering pump speed to maintain a setpoint adjustable ratio. The “flow required” value shall be calculated based on:

1) Dosage: Amount of sodium hypochlorite in ppm (parts per million) required to treat the flow from saline filter feed pumps. This value shall be coordinated with the Owner and the Engineer during startup.

2) Process Flow: Flow from saline filter feed pumps (MGD).

3) Chemical concentration: The concentration (ppm) of the sodium hypochlorite solution being used.

4) Specific gravity: The specific gravity of the sodium hypochlorite solution.

Software Interlocks

PLC logic shall prevent the metering pump from starting if any of the following conditions are met. This applies to both remote manual and remote automatic mode.

1) All bulk storage tanks currently enabled via SCADA are simultaneously in low level alarm condition.

2) Flow from saline filter feed pumps signal lost or out of range.

e. Headworks Odor Control system

Feedback Control Mode

If an H_2S or ORP sensor is provided by others and a 4-20 mA signal becomes available via SCADA, the PLC shall allow automatic control of the sodium hypochlorite dosing pump based on that analog signal. A selection switch shall be provided in the SCADA HMI to allow the operator to enable or disable this mode.

A PID control loop, managed by PLC-4, shall maintain an operator defined H_2S or ORP setpoint received from SCADA. The PID control loop shall continuously adjust chemical dosing to maintain the operator-defined setpoint.

Software Interlocks

PLC logic shall prevent the metering pump from starting if any of the following conditions are met. This applies to both remote manual and remote automatic mode.

1) All bulk storage tanks currently enabled via SCADA are simultaneously in low level alarm condition.

2) Loss of signal or out-of-range condition from the H_2S or ORP sensor, if Feedback Control Mode is selected.

3) No running status signal received from any recirculation pump associated with the scrubber system.

4) No running status signal received from any fan associated with the scrubber system.

f. Effluent Pump Station

Ratio Control

The feed automatic control logic shall calculate the flow required to maintain a ratio of sodium hypochlorite to total effluent flow by using equation (1) in Section 3.03 above. The calculated “flow required” value shall be used by the PLC logic to modulate the duty metering pump speed to maintain a setpoint adjustable ratio. The “flow required” value shall be calculated based on:

1) Dosage: Amount of sodium hypochlorite in ppm (parts per million) required to treat the effluent flow. This value shall be coordinated with the Owner and the Engineer during startup.

2) Process Flow: The total effluent flow (in MGD), which provides the feedforward basis for the ratio control.

3) Chemical concentration: The concentration (ppm) of the Sodium Hypochlorite solution being used.

4) Specific gravity: The specific gravity of the Sodium Hypochlorite solution.

Feedback Control

PLC automatic control strategy shall incorporate a sodium hypochlorite trim to enhance the flow rate control. It shall be possible to enable/disable this feature from the SCADA. The trim logic will only execute if the ratio setpoint falls outside of an adjustable deadband and shall be executed based on a SCADA adjustable duration that continuously repeats. There shall be two selectable options for sodium hypochlorite trim that were explained in Section 3.03-B above. PLC logic shall use the effluent chlorine residual signal to trim the dosing setpoint.

Software Interlocks

PLC logic shall prevent the metering pump from starting if any of the following conditions are met. This applies to both remote manual and remote automatic mode.

1) All bulk storage tanks currently enabled via SCADA are simultaneously in low level alarm condition.

2) Effluent flow signal lost or out of range.

3) Chlorine residual signal lost or out of range.

g. RAS Pump Station

Ratio Control

The feed automatic control logic shall calculate the flow required to maintain a ratio of sodium hypochlorite to total RAS flow by using equation (1) in Section 3.03 above. The calculated “flow required” value shall be used by the PLC logic to modulate the duty metering pump speed to maintain a setpoint adjustable ratio. The “flow required” value shall be calculated based on:

1) Dosage: Amount of sodium hypochlorite in ppm (parts per million) required to treat the total RAS flow. This value shall be coordinated with the Owner and the Engineer during startup.

2) Process Flow: The total RAS flow (in MGD), which provides the feedforward basis for the ratio control.

3) Chemical concentration: The concentration (ppm) of the Sodium Hypochlorite solution being used.

4) Specific gravity: The specific gravity of the Sodium Hypochlorite solution.

Software Interlocks

PLC logic shall prevent the metering pump from starting if any of the following conditions are met. This applies to both remote manual and remote automatic mode.

1) All bulk storage tanks currently enabled via SCADA are simultaneously in low level alarm condition.

2) Total RAS flow signal lost or out of range.

h. Influent Pump station

Ratio Control

The feed automatic control logic shall calculate the flow required to maintain a ratio of sodium hypochlorite to total influent flow by using equation (1) in Section 3.03 above. The calculated “flow required” value shall be used by the PLC logic to modulate the duty metering pump speed to maintain a setpoint adjustable ratio. The “flow required” value shall be calculated based on:

1) Dosage: Amount of sodium hypochlorite in ppm (parts per million) required to treat the influent flow. This value shall be coordinated with the Owner and the Engineer during startup.

2) Process Flow: The total influent flow (in MGD), which provides the feedforward basis for the ratio control.

3) Chemical concentration: The concentration (ppm) of the Sodium Hypochlorite solution being used.

4) Specific gravity: The specific gravity of the Sodium Hypochlorite solution.

Software Interlocks

PLC logic shall prevent the metering pump from starting if any of the following conditions are met. This applies to both remote manual and remote automatic mode.

1) All bulk storage tanks currently enabled via SCADA are simultaneously in low level alarm condition.

2) Total influent flow signal lost or out of range.

3.08 ADDITIONAL PLC AND SCADA HMI PROGRAMMING

A. In addition to the SCADA graphics screens modifications and additions described in this Division and indicated on the Drawings, the Contractor, through the instrumentation and controls subcontractor, shall furnish and install up to two (3) new SCADA HMI graphic screens, ten (10) unique SCADA pop-up notifications, and five (5) unique SCADA equipment faceplates at the request of the Engineer at no additional cost to the City.

B. In addition to the PLC functions described in this Section and indicated on the Drawings, the Contractor, through the instrumentation and controls subcontractor, shall furnish and install up to ten (10) additional Ethernet network-based interlocks and up to ten (10) additional monitoring/control functions between existing PLC-4 and any other PLC, which is considered necessary to provide a fully functional control system based on the opinion of the Engineer at no additional cost to the City.

END OF SECTION

SECTION 40 71 43
VARIABLE AREA FLOW METERS

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish, test, install and place in satisfactory operation all variable area flow meters (i.e., rotameters), with all spare parts, accessories, and appurtenances as herein specified and as shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 40 61 13 – Process Control System General Provisions

B. Section 40 70 00 – Instrumentation for Process Systems

PART 2 – PRODUCTS

2.01 ROTAMETERS

A. Variable area flow meters shall consist of a float chamber, tapered float, and a measuring ring.

B. Variable area flow meters shall have the following specifications:

Description	Prechlorination Filters	Hydraulic Box/Injection Well Valve Panel
Tubing or Pipe Connection	1/4” or 1/8” with compression fitting adapters	1”
Flow range (Nominal)	0.2-2.0 GPH	30-300 GPH or 0.5-5.0 GPM
Accuracy	± 3% full scale accuracy	± 3% of full scale
Calibration Fluid	12.5% Sodium Hypochlorite, specific gravity 1.20, dynamic viscosity 1.7 cP	12.5% Sodium Hypochlorite, specific gravity 1.20, dynamic viscosity 1.7 cP
Environment	Acceptable for direct sunlight exposure	Acceptable for direct sunlight exposure
Max Process Fluid Temperature:	150 degrees F (65 degrees C) @ 0 PSI	150 degrees F (65 degrees C) @ 0 PSI
Max. Process Fluid Pressure	150 PSI (10.3 bar) @ 70°F (21°C)	150 psi (10.3 bar) at 70°F (21°C)
Tube Material	PVDF	PVDF

Description	Prechlorination Filters	Hydraulic Box/Injection Well Valve Panel
Float Material	PVDF	PVDF
Ends	Socket or Threaded	Socket or Threaded
O-Rings	Viton	Viton

C. The table above sets the standard for the variable area flowmeter. To allow material variability among manufacturers, the following additional information is provided:

1. Body (Optional): Acrylic or compatible with 12.5% Sodium Hypochlorite.

2. Float (Optional): Compatible with 12.5% Sodium Hypochlorite.

3. Float Guide Rods: Not preferred.

4. O-Rings (Optional): Viton (FKM), PTFE, or compatible with 12.5% Sodium Hypochlorite.

D. A graduated shall be provided for flow indication. The indicator shall be large, easy to read, and calibrated per the chemical used and in the units as follows:

1. Prechlorination Filters: In gallons per hour (GPH)

2. Hydraulic Box/Injection Well Valve Panel: In gallons per hour (GPH) or gallons per minute (gpm)

E. Rotameter shall have an integral needle or globe valve for adjustment of flow rate. Where the selected manufacturer does not provide this option, an externally mounted globe valve will be acceptable. For line sizes 1/2” and smaller, provide needle valve.

F. Variable area flow meters shall be as manufactured by Brooks, Chemline Plastics, Fischer & Porter, King Instruments, or equal.

PART 3 – EXECUTION

3.01 REQUIREMENTS

A. Refer to Section 40 70 00 – Instrumentation for Process Systems.

END OF SECTION

SECTION 46 41 42
CHEMICAL INJECTION ASSEMBLIES

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish, install, test, adjust, and place in satisfactory operation chemical injection assemblies as shown on the Drawings and as specified herein.

B. Equipment shall be provided in accordance with the requirements of Section 46 00 00 - Equipment General Provisions, and Division 40 – Process Interconnections.

1.02 OPERATING CONDITIONS AND PERFORMANCE REQUIREMENTS

A. Chemical Injection Assemblies

Service	~~**Sodium Hypochlorite**~~	~~**Sodium Hypochlorite**~~	**Sodium Hypochlorite**	**Sodium Hypochlorite**
Application Point	~~Non-potable and Reuse Perchlorinating~~	~~Non-potable and Reuse CCT (0.25"), Outfall (1")~~	Influent Pump Station, RAS 1-5	Headworks **Odor Control**
No. of Assemblies	~~2~~	~~6~~	6	2
Type of Feed Device	~~Retractable Injector~~	~~Fixed Injector~~	Fixed Injector	(1)
Maximum Concentration	~~18% (12.5% intended)~~	~~18% (12.5% intended)~~	18% (12.5% intended)	18% (12.5% intended)
Injector Size	~~0.25"~~	~~0.25" (4), 1" (2)~~	~~0.75"~~**0.5"**	0.~~375"~~**0.5"**
Injection Quill Type	~~Standard Service~~	~~PVC Service~~	PVC Service	PVC Service
Chemical Pipe Material	~~PVC~~	~~PVC~~	PVC	PVC
Maximum Chemical Feed Rate	~~5.07 gph~~	~~11.3gph, 275gph~~	93.3 gph	~~26.7~~**88** gph
Max Chemical Discharge Pressure	~~58 psi~~	~~145 psi, 58 psi~~	58 psi	58 psi
Receiving Pipe Diameter	~~24"~~	~~3", 4"~~	3"	(1)
Receiving Pipe Material	~~Ductile Iron~~	~~PVC Sch 80~~	PVC Sch 80	(1)
Maximum Receiving Pipe Pressure	~~13 psi~~	~~75 psi~~	75 psi	(1)
Maximum Receiving Pipe Velocity	~~5 fps~~	~~5 fps~~	5 fps	5 fps

1. Coordinate with separate Headworks Odor Control improvement project.

1.03 SUBMITTALS

A. The following items shall be submitted with the Shop Drawings in accordance with, or in addition to, the submittal requirements specified in Section 01 33 00 – Submittal Procedures, and Section 46 00 00 – Equipment General Provisions:

1. Equipment specifications and data sheets, with identification of all materials of construction.

2. Complete assembly, layout, installation and shop drawings, with clearly marked dimensions, tolerances, jointing and anchoring details.

3. Weights of equipment component parts.

4. Chemical resistance data for wetted parts.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. The chemical injection assemblies shall be as manufactured by SAF-T-FLO Water Services, Inc., Koflo, or approved equal.

2.02 CONSTRUCTION AND MATERIALS

A. Each injection assembly shall be specifically designed for the particular chemical service for which it is being supplied. The materials of construction for the assemblies shall be compatible with the chemicals being fed and shall be suitable for the pressure in the chemical solution line and receiving pipe, the maximum velocity in the receiving pipe, and the insertion length.

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B. Acceptable injection assembly construction shall be as follows:

Standard Service and PVC Service Quill	Sodium Hypochlorite
Isolation Valve	Threaded CPVC or Brass (standard service only)
Tube	PVC or CPVC
Tip Configuration	45° Bevel on small quills, SAF-T-Seal Tip (FKM) on available quill sizes
Check Valve Material	PVC or CPVC with Titanium springs and Ceramic ball
Check Valve Seal	FKM
Flexible Tubing Assembly:	
Valve	CPVC or PVC
Seal	FKM
Tubing	Reinforced PVC
End Connection	Compression Tube Fitting with FNPT

C. The injection assemblies shall be retractable for the standard service quills and furnished with an isolation assembly, solution tube assembly including check valve , SAF-T-Seal (for available quill sizes), locking device, and a safety chain for the standard service quill. The locking device shall connect the solution tube to the corporation stop on the receiving pipe to prevent accidental withdrawal of the solution tube. A stainless steel safety chain shall prevent the solution tube from being withdrawn past the compression ring in the gland. Safety chain length shall be determined by the manufacturer based on solution tube length.

D. The assemblies shall be sized to match the pump discharge line or injection flow rate and shall be of the same diameter as the chemical piping. The injection assembly solution tubes shall penetrate into the pipe a distance equivalent to a minimum of 1/3 of the pipe diameter into which the chemicals are being injected.

E. Each injector shall be furnished with a flexible hose assembly consisting of flexible hose/tubing, connection fittings, seals and ball valve, specifically designed for the particular chemical service for which it is being supplied. Flexible hose assembly shall also be capable of withstanding maximum pump discharge line pressure.

PART 3 – EXECUTION

3.01 MANUFACTURER'S FIELD SERVICES

A. The services of a qualified manufacturer's technical representative shall be provided in accordance with Section 46 00 00 – Equipment General Provisions.

Service	Number of Trips	Number of Days/Trip
Installation, Testing, and Training	1	1

3.02 INSTALLATION

A. The Contractor shall furnish the chemical injectors and all associated equipment and accessories as required and specified herein in accordance with the manufacturer's instructions and in accordance with Section 46 00 00 – Equipment General Provisions.

END OF SECTION