



**CITY OF HOLLYWOOD
FLORIDA**

CONTRACT DOCUMENTS

**SOUTHERN REGIONAL WASTEWATER
TREATMENT PLANT**

RAS PUMP STATION NO. 1 REPLACEMENT

CITY PROJECT NO. 17-9523

BID DOCUMENTS
VOLUME 1 OF 2

SEPTEMBER 2019

Hazen

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

Engineers Project No. 4321-077

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RAS PUMP STATION NO. 1 REPLACEMENT

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VOLUME 2 OF 2

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CITY OF HOLLYWOOD
DEPARTMENT OF PUBLIC UTILITIES
ENGINEERING AND CONSTRUCTION SERVICES DIVISION

SECTION 00030

NOTICE TO BIDDERS

PROJECT NAME: RAS PUMP STATION NO. 1 REPLACEMENT

PROJECT NUMBER: 17-9523

NOTICE IS HEREBY GIVEN that the City Commission of the City of Hollywood, Florida, is advertising for sealed bids which shall be submitted to the City Clerk's Office (City Hall, 2600 Hollywood Blvd., Room 221) of the City of Hollywood, Florida, **until 2:00 p.m., local time, November 12, 2019.** On **November 12, 2019 at 2:30 p.m.** the bids will be opened and read publicly in the Department of Public Utilities, Engineering and Construction Services Division Conference Room at 1621 N. 14th Avenue, Building A, Hollywood, Florida.

A mandatory pre-bid conference will be held on October 22, 2019 at 3:00 p.m., at the Southern Regional Wastewater Treatment Plant, located at 1621 North 14th Avenue, Hollywood, Florida, 33020, ECSD Conference Room, Building A.

The Bid Package and Contract documents can be downloaded at: www.hollywoodfl.org/Purchasing/Bids
The Bid Package and Contract documents may also be obtained, upon request, at a cost of \$200 from the Department of Public Utilities - ECSD at 1621 North 14th Avenue in Hollywood. Technical assistance shall be submitted in writing, by **November 5, 2019** to the Senior Project Manager, Feng Jiang, P.E., fjiang@hollywoodfl.org

Each bid must be accompanied by a Bid Security in an amount no less than ten percent (10%) of the bid amount. Said security shall be in the form of a Certified Check or Cashier's Check on a solvent National or State Bank, or a bid bond executed by the Bidder and a qualified Surety, satisfactory and payable to the City of Hollywood, Florida.

A Cone of Silence is in effect with respect to this bid. The Cone of Silence prohibits certain communications between potential vendors and the City. For further information, please refer to Section 30.15(E) of the City's Code of Ordinances.

The City of Hollywood is strongly committed to ensuring the participation of local Hollywood vendors in the procurement of goods and services. For additional information about the City's Local Preference Ordinance, visit www.hollywoodfl.org.

It will be the Bidder's sole responsibility to hand-deliver or mail his/her proposal to the City Clerk's Office at City Hall on or before the closing hour and date for the receipt of bids as noted above.

The City Commission reserves the right to reject any or all bids, to waive informalities and to accept or reject all or any part of any bid, as they may deem to be in the best interest of the City of Hollywood, Florida.

Dated this 30th Day of September, 2019

CITY OF HOLLYWOOD, FLORIDA

Clece Aurelus, P.E., Engineering Support Services Manager
Department of Public Utilities - ECSD

SECTION 00100

INSTRUCTIONS TO BIDDERS

1. PREPARATION OF BIDS:

Bids must be submitted on the separate and enclosed **BIDDING PACKAGE** forms, which shall be completed **by typewriter** or legibly handwritten in ink. The Bid price of each item on the form must be stated in words and numerals; in case of a conflict, words will take precedence. Where unit prices and extended totals are required, unit prices take precedence. Likewise, discrepancies between the indicated sum of any column of figures and the correct sum thereof will be resolved in favor of the correct sum.

If the Bid is made by an individual, he must sign his name therein and state his address. If the Bid is made by a firm or partnership, its name and address must be stated, as well as the name and address of each member of the firm or partnership. Bids by corporations must be signed by an authorized corporate officer (accompanied by evidence of authority to sign) and the corporate seal must be affixed and attested by the Secretary or an Assistant Secretary of the corporation. The corporate address and state of incorporation shall be shown below the signature. When the state of incorporation is other than Florida, proof of registry with Florida must be attached.

2. RECEIPT AND OPENING OF BIDS:

The separate **BIDDING PACKAGE** consisting of the PROPOSAL, PROPOSAL BID FORM, APPROVED BID BOND, TRENCH SAFETY FORM, INFORMATION REQUIRED FROM BIDDERS AND LIST OF SUBCONTRACTORS AND/OR MATERIAL SUPPLIERS shall be completed, signed and sealed as required and must be delivered in a sealed, opaque envelope, addressed to the City Clerk of Hollywood, Florida, by the time called for in the Notice to Bidders and shall be properly identified on the face thereof.

Proposals will be publicly opened and immediately read aloud at the time and place designated in the Notice to Bidders. No proposal will be considered which is not based upon these Drawings and Specifications, or which contains any letter or written memorandum qualifying the same, or which is not properly made out and signed in writing by the Bidder.

3. PRE-BID CONFERENCE:

A Pre-bid Conference will be held at the City of Hollywood Southern Regional Wastewater Treatment Plant, 1621 N. 14th Avenue, Hollywood, Florida, 33020 on October 22, 2019 at 3:00 p.m. All Contractors planning to submit a bid are required to attend the meeting.

4. CONTRACT DOCUMENTS:

The Contract Documents give the location and description of the work to be done under this Contract and estimated quantities of each item of work for which Bids are invited, the time in which the work must be completed, the amount of the Bid Guaranty, if any, and the date, time and place of the receipt and opening of the Bids.

5. EXAMINATION OF CONTRACT DOCUMENTS AND SITE:

The Bidder is required to carefully examine the site of the work and the Contract Documents for the work contemplated. It will be assumed that the Bidder has investigated and is fully informed as to the requirements of the Contract Documents, laws, ordinances, codes and any other factors which may affect the performance of the work. Failure to be so informed will not relieve a successful Bidder of his obligation to furnish all material, equipment and labor necessary to carry out the provision of the Contract Documents and to complete the contemplated work for the consideration set forth in his Bid.

6. DIMENSIONS, QUANTITIES AND SUBSURFACE INFORMATION:

Dimensions, quantities and subsurface information supplied by the City are in no way warranted to indicate true amounts or conditions. Bidders/Contractors shall neither plead misunderstanding or deception, nor make claims against the City if the actual amounts, conditions or dimensions do not conform to those stated. Any "Outside" reports made available by the Engineer are neither guaranteed as to accuracy or completeness, nor a part of the Contract Documents.

7. ADDENDA - CHANGES WHILE BIDDING:

During the Bidding period, Bidders may be furnished addenda or bulletins for additions or alterations to the Plans or Specifications which shall be included in the work covered by the Proposal.

Any prospective Bidder in doubt as to the meaning of any part of the Drawings, Specifications or other Contract Documents may submit a written request to the Engineer for an interpretation. The Bidder submitting the request will be responsible for its prompt delivery. Any interpretation of the documents will be made by an addendum and a copy of such addendum will be mailed or delivered to each prospective Bidder who has received a set of documents. The City will not be responsible for any other explanations or interpretations of the proposed documents.

8. BID GUARANTY:

A Bid Guaranty in the form of a Cashier's Check, Certified Check or Bid Bond executed by the Bidder and a qualified Surety in the amount of **10%** of the Bid is required for this project in accordance with the Notice to Bidders.

9. TRENCH SAFETY FORM:

The Trench Safety Form included in the Bid Documents must be completed and signed. Noncompliance with this requirement may invalidate the bid.

10. QUALIFICATIONS AND DISQUALIFICATIONS OF BIDDERS:

The Contract will be awarded only to a Bidder, who in the opinion of the Engineer, is fully qualified to undertake the work and is in compliance with the City's Local Preference Criteria (when applicable). The City reserves the right before awarding the Contract to require a Bidder to submit such evidence of his qualifications as it may deem necessary and may consider any available evidence of his financial status, technical qualifications and other qualifications and abilities. Any one of the following causes, among others, may be considered as sufficient justification to disqualify a Bidder and reject his Bid:

- A. Submission of more than one Bid for the same work by an individual, firm, partnership or corporation under the same or different names.
- B. Evidence of collusion.
- C. Previous participation in collusive Bidding on work for the City of Hollywood, Florida.
- D. Submission of an unbalanced Bid in which the prices Bid for some items are out of proportion to the prices Bid for other items.
- E. Lack of competency. The Engineer may declare any Bidder ineligible, at any time during the process or receiving Bids or awarding the Contract, if developments arise which, in his opinion, adversely affects the Bidder's responsibility. The Bidder will be given an opportunity, by the Engineer, to present additional evidence before final action is taken. The Bidder shall provide proof that their past experience can demonstrate similar or better complexity and size compared to this Contract.
- F. Lack of responsibility as shown by past work judged by the Engineer from the standpoint of workmanship and progress.
- G. Non-compliance with the City's Local Preference (when applicable).
- H. Uncompleted work for which the Bidder is committed by Contract, which is in the judgment of the Engineer, might hinder or prevent the prompt completion of work under this Contract.
- I. Being in arrears on any existing Contracts with the City, or any taxes, licenses or other monies due the City; in litigation with the City or having defaulted on a previous contract with the City.

11. LIFE AND WITHDRAWAL OF BID:

All Bids shall remain open for 90 days after the day of the Bid opening, however, the Engineer may, at his sole discretion, release any Bid and return the Bid Guaranty prior to that date. Any Bid may be modified or withdrawn prior to the time scheduled for the opening of Bids.

12. REJECTION OF IRREGULAR BIDS:

Bids will be considered irregular and may be rejected if they show omissions, alterations of form, additions not called for, conditions, limitations, unauthorized alternate Bids or other irregularities of any kind.

13. BIDDING ERRORS:

If after the opening of bids, a Bidder claims an error and requests to be relieved of the Award, or the Engineer believes that an error may have been made then, the Bidder shall present his work sheets and supplier quotations to the Engineer for verification. This information shall be presented on the same day as the bid opening or if the opening is in the afternoon then on the following business day. When the Engineer has suspected an error and requires the documents, Bidder's failure to produce them within the time specified shall make the Bidder non-responsive and thereby eligible for disqualification. Award may then be made to the next lowest responsive, responsible Bidder, or the work may be readvertised or it may be performed by City forces, as the Commission desires.

14. AWARD OF CONTRACT:

The City Commission reserves the right to reject any or all Bids, or any part of any Bid, to waive any informality in any Bid, or to re-advertise for all or any part of the work contemplated. If Bids are found to be acceptable by the City Commission, written notice of award will be given to the lowest responsive, responsible Bidder.

15. EXECUTION OF CONTRACT:

The Bidder to whom the Contract is awarded shall, within ten days of the date of award, execute and deliver three (3) copies of the following to the Engineer.

- A. The Contract
- B. Performance and Payment Bond
- C. Evidence of required Insurance
- D. Proof of authority to execute the Contract
- E. Proof of authority to execute the Bond on behalf of the Awardee

- F. List of Subcontractors, estimated Contract Value for each and proof that such subcontractors possess all required Federal, State, County and/or municipality licenses, including but not limited to certified of competency and occupational license.

The above documents must be furnished, executed and delivered before the Contract will be executed by the City. The Contract shall not be binding upon the City until it has been executed by the City and a copy of such fully executed Contract is delivered to the Contractor.

16. FAILURE TO EXECUTE CONTRACT, BID GUARANTY FORFEITED:

Should the Bidder to whom the Contract has been awarded refuse or fail to complete the requirements of Article 15 above within ten (10) days after Notice of Award, the additional time in days (including weekends) required to CORRECTLY complete the documents will be deducted, in equal amount, from the Contract Time, or the City may elect to revoke the Award. In the same manner as Article 13, the Bid Guaranty of any Bidder failing to execute the awarded Contract shall be retained by the City and the Contract awarded as the Commission desires.

17. GUARANTY OF FAITHFUL PERFORMANCE AND PAYMENT:

A Performance Bond and a Payment Bond each equal to 100 percent of the total Bid will be required of the Awardee. The Bond must be written through a company licensed to do business in the State of Florida and be rated at least "A", Class X, in the latest edition of "Best's Key Rating Guide", published by A.M. Best Company. As per Florida Statute Section 255.05, the Contractor shall be required to record the payment and performance bonds in the public records of Broward County.

18. INSURANCE:

Bidder must satisfy all insurance requirements as set forth in the Supplementary and General Conditions.

The insurance policy shall not contain any exceptions that would exclude coverage for risks that can be directly or reasonably related to the scope of goods or services in this bid/proposal. A violation of this requirement at any time during the term, or any extension thereof shall be grounds for the immediate termination of any contract entered in to pursuant to this bid/proposal. In order to show that this requirement has been met, along with an insurance declaration sheet demonstrating the existence of a valid policy of insurance meeting the requirements of this bid/proposal, the successful proposer must submit a signed statement from insurance agency of record that the full policy contains no such exception.

19. QUALIFICATIONS:

At the time of submission of the bid, Bidder must possess, and be able to provide City, any and all required Federal, State, County and/or municipal licenses, including but not limited to certificates of competency and occupational licenses. Moreover, upon receipt of the Award of the Contract, Bidder must provide proof of valid licensing for all subcontractors and/or material suppliers hired by the Contractor.

When the Bidder is a Joint Venture, in order to satisfy the construction licensing requirements one member of a Joint Venture must hold a valid state certificate as well as the appropriate county and city license. The Contractor shall be held responsible for assurance that all subcontractors and/or material suppliers hired by the Contractor have the appropriate state certificate and licenses.

20. PERMITS:

The Contractor and Subcontractors must obtain Building Permits required for all work covered under this Contract as well as any other permit required by any other regulatory agency. The Master Building Permit required by the City shall be obtained by the Contractor but paid for by the City. Any and all other permits required by the City, County, State of Florida, or any other regulatory agency shall be obtained and paid for by the Contractor.

The Contractor or Subcontractors shall also be responsible to call for all inspections as required in Section 105 (Inspections) of the latest edition of the Florida Building Code.

- END OF SECTION -

SECTION 00200



NOTICE TO ALL BIDDERS AND PROPOSERS

Cone of Silence

The City of Hollywood City Commission adopted Ordinance No. O-2007-05, which created Section 30.15(E) imposing a Cone of Silence for certain City purchases of goods and services.

The Cone of Silence refers to limits on communications held between vendors and vendor's representatives and City elected officials, management and staff during the period in which a Formal Solicitation is open.

The Ordinance does allow potential vendors or vendor's representatives to communicate with designated employees for the limited purpose of seeking clarification or additional information. The names and contact information of those employees that may be contacted for clarification or additional information are included in the solicitation.

The Cone of Silence does not prohibit a vendor or vendor's representative from communicating verbally, or in writing to the City Manager, the City Manager's designee, the City Attorney or the City Attorney's designee on those procurement items to be considered by the City Commission.

The Cone of Silence does not prohibit a vendor or vendor's representative from making public presentations at a duly noticed pre-bid conference or duly noticed evaluation committee meeting or from communicating with the City Commission during a duly noticed public meeting.

The Cone of Silence shall be imposed when a formal competitive solicitation has been issued and shall remain in effect until an award is made, a contract is approved, or the City Commission takes any other action which ends the solicitation.

To view the Cone of Silence, Ordinance No. O-2007-05, go to the City of Hollywood's Official website at <http://www.hollywoodfl.org/ConeOfSilence>

- END OF SECTION -

SECTION 00300

PROPOSAL

TO THE MAYOR AND COMMISSIONERS
CITY OF HOLLYWOOD, FLORIDA

SUBMITTED 11/12/19

Dear Mayor and Commissioners:

The undersigned, as BIDDER, hereby declares that the only person or persons interested in the Proposal as principal or principals is or are named herein and that no other person than herein mentioned has any interest in this Proposal or in the Contract to be entered into; that this Proposal is made without connection with any other person, company or parties making a Bid or Proposal; and that it is in all respects fair and in good faith without collusion or fraud.

The BIDDER further declares that he has examined the site of the Work and informed himself fully in regard to all conditions pertaining to the place where the Work is to be done; that he has examined the Drawings and Specifications for the Work and contractual documents relative thereto, including the Notice to Bidders, Instructions to Bidders, Proposal Bid Form, Form of Bid Bond, Form of Contract and Form of Performance Bond, General, Supplementary and Technical Specifications, Addenda, Drawings, and Local Preference, Exhibit A, and has read all of the Provisions furnished prior to the opening of bids; and that he has satisfied himself relative to the work to be performed.

The undersigned BIDDER has not divulged to, discussed or compared his bid with other bidders and has not colluded with any other BIDDER of parties to this bid whatever.

If this Proposal is accepted, the undersigned BIDDER proposes and agrees to enter into and execute the Contract with the City of Hollywood, Florida, in the form of Contract specified; of which this Proposal, Instructions to Bidders, General Specifications, Supplementary Conditions and Drawings shall be made a part for the performance of Work described therein; to furnish the necessary bond equal to one hundred (100) percent of the total Contract base bid, the said bond being in the form of a Cash Bond or Surety Bond prepared on the applicable approved bond form furnished by the CITY; to furnish all necessary materials, equipment, machinery, tools, apparatus, transportation, supervision, labor and all means necessary to construct and complete the work specified in the Proposal and Contract and called for in the Drawings and in the manner specified; to commence Work on the effective date established in the "Notice to Proceed" from the ENGINEER; and to substantially complete all Contract Work within **630 days** with final completion within **660 days**, as stated in the "Notice to Proceed" or pay liquidated damages for each calendar day in excess thereof, or such actual and consequential damages as may result therefrom, and to abide by the Local Preference (when applicable).

The BIDDER acknowledges receipt of the following addenda:

No. <u>01</u>	Dated <u>11/12/19</u>
No. _____	Dated _____
No. _____	Dated _____
No. _____	Dated _____
No. _____	Dated _____

And the undersigned agrees that in case of failure on his part to execute the said Contract and the Bond within ten (10) days after being presented with the prescribed Contract forms, the check or Bid Bond accompanying his bid, and the money payable thereon, shall be paid into the funds of the City of Hollywood, Florida, otherwise, the check or Bid Bond accompanying this Proposal shall be returned to the undersigned.

Attached hereto is a certified check on the

_____ Bank of _____

or approved Bid Bond for the sum of

10% of Bid Proposal Dollars (\$) according to the conditions under the Instructions to Bidders and provisions therein.

NOTE: If a Bidder is a corporation, the legal name of the corporation shall be set forth below, together with signature(s) of the officer or officers authorized to sign Contracts on behalf of the corporation and corporate seal; if Bidder is a partnership, the true name of the firm shall be set forth below with the signature(s) of the partner or partners authorized to sign Contracts in behalf of the partnership; and if the Bidder is an individual, his signature shall be placed below; if a partnership, the names of the general partners.

WHEN THE BIDDER IS AN INDIVIDUAL:

(Signature of Individual)

(Printed Name of Individual)

(Address)

WHEN THE BIDDER IS A SOLE PROPRIETORSHIP OR OPERATES UNDER A TRADE NAME:

(Name of Firm)

(Address)

(Signature of Individual) (SEAL)

WHEN THE BIDDER IS A PARTNERSHIP:

(Name of Firm) A Partnership

(Address)

By: _____ (SEAL)
(Partner)

Name and Address of all Partners:

WHEN THE BIDDER IS A JOINT VENTURE:

(Correct Name of Corporation)

By: _____ (SEAL)
(Address)

(Official Title)

As Joint Venture
(Corporate Seal)

Organized under the laws of the State of _____, and authorized
by the law to make this bid and perform all Work and furnish materials and equipment
required under the Contract Documents.

WHEN THE BIDDER IS A CORPORATION:

Intercounty Engineering, Inc.

(Correct Name of Corporation)

By:  (SEAL)

Stephen Polk, Vice President
(Official Title)

1925 NW 18 Street, Pompano Beach, FL 33069
(Address of Corporation)

Organized under the laws of the State of Florida, and authorized by the law to make this bid and perform all Work and furnish materials and equipment required under the Contract Documents.

CERTIFIED COPY OF RESOLUTION OF
BOARD OF DIRECTORS

Intercounty Engineering, Inc.
(Name of Corporation)

RESOLVED that Stephen Polk
(Person Authorized to Sign)

Vice President of Intercounty Engineering, Inc.
(Title) (Name of Corporation)

be authorized to sign and submit the Bid or Proposal of this corporation for the following project:

CITY OF HOLLYWOOD
RAS PUMP STATION NO. 1 REPLACEMENT
PROJECT NO. 17-9523

The foregoing is a true and correct copy of the Resolution adopted by

Intercounty Engineering, Inc. at a meeting of its Board of _____
(Name of Corporation)

Directors held on the 12th day of November, 20 19.

By: 

Title: Stephen Polk, Sec/Vice President

(SEAL)

The above Resolution MUST BE COMPLETED if the Bidder is a Corporation.

- END OF SECTION -

SECTION 00301
CITY OF HOLLYWOOD
DEPARTMENT OF PUBLIC UTILITIES
ENGINEERING & CONSTRUCTION SERVICES DIVISION
PROPOSAL BASE BID FORM

Project No.: 17-9523
Project Name: RAS PUMP STATION NO.1 REPLACEMENT

BASE BID

Item No.	Estimated Quantity	Description	Unit Price	Extension or Total
1	Lump Sum	Mobilization for the lump sum price of (shall not exceed 3% of the sum of Line Item Nos. 2 through 8): <u>One Hundred Seventy eight thousand</u> Dollars and <u>NO</u> Cents	--	\$ <u>178,000.00</u>
2	Lump Sum	Perform all work associated with the RAS Pump Station No. 1 Replacement in accordance with the Contract Documents (including all work not defined by Bid Item Nos. 1, 3 through, 8, and 13) for the lump sum price of: <u>Two Million</u> Dollars and <u>NO</u> Cents	--	\$ <u>2,000,000.00</u>
3	Lump Sum	Leak repair at RAS Pump Station / Clarifier for the lump sum price of: <u>forty six thousand</u> Dollars and <u>NO</u> Cents	--	\$ <u>46,000.00</u>
4	Lump Sum	Perform all work associated with Oxygenation Train Nos. 1 and 2 patch and leak repair: <u>Two Hundred Seventy thousand</u> Dollars and <u>NO</u> Cents	--	\$ <u>270,000.00</u>

Item No.	Estimated Quantity	Description	Unit Price	Extension or Total
5	Lump Sum	Perform all work associated with retrofit of existing 18-inch RAS valves, north of Oxygenation Trains 1 and 2, with electric actuators: <i>Two Hundred Thirty-eight Thousand</i> Dollars and <i>NO</i> Cents	--	\$ <u>238,000.00</u>
6	Lump Sum	Perform all work associated with retrofit of existing 16-inch RAS valves at RAS Pump Station No. 2 with electric actuators: <i>One Hundred Eighty-three Thousand One Hundred</i> Dollars and <i>NO</i> Cents	--	\$ <u>183,100.00</u>
7	Lump Sum	Perform all work associated with RAS Pump Station No. 3: <i>Two Hundred Fifty-six Thousand Two Hundred Eighteen</i> Dollars and <i>NO</i> Cents	--	\$ <u>256,518.00</u>
8	Lump Sum	Perform all work associated with RAS Pump Station No. 4: <i>Six Hundred Fifty-two Thousand Six Hundred</i> Dollars and <i>NO</i> Cents	--	\$ <u>252,600.00</u>
9	Allowance	Dedicated cost allowance for inspections and testing: Fifty thousand ----- Dollars and No ----- Cents	--	\$ <u>50,000.00</u>
10	Allowance	Permits, licenses and fee allowance of: Thirty thousand ----- Dollars and No ----- Cents	--	\$ <u>30,000.00</u>

Item No.	Estimated Quantity	Description	Unit Price	Extension or Total
11	Allowance	Dedicated cost allowance for work as directed and upon authorization by the City due to undefined conditions of: <u>Two hundred fifty thousand</u> Dollars and <u>No</u> Cents	--	\$ <u>250,000.00</u>
12	\$10	Consideration for Indemnification for the lump sum price of: <u>Ten</u> Dollars and <u>No</u> Cents	--	\$ <u>10.00</u>
13	Lump Sum	Complete all work, including site cleanup, restoration, and demobilization (shall not exceed 2% of the sum of Line Item Nos. 2 through 8): <u>Seventy six thousand</u> Dollars and <u>No</u> Cents	--	\$ <u>76,000.00</u>
14	TOTAL BASE BID FOR PROPOSAL ITEMS 1 THROUGH 13			
	Written:	<u>Three Million Eight Hundred Thirty Thousand Two Hundred Twenty eight</u> Dollars and <u>No</u> Cents		
				\$ <u>3,830,228.00</u>

NOTES:

1. REFER TO SECTION 01025 FOR ADDITIONAL DESCRIPTION OF ITEMS.
2. SUBSTANTIAL COMPLETION TIME AND PROJECT CLOSEOUT TIME FOR THE WORK SHALL BE AS DEFINED IN THE PROJECT SCHEDULE IN THE SUPPLEMENTARY GENERAL CONDITIONS (SGC'S).
3. THE CITY OF HOLLYWOOD REQUIRES THE CONTRACTOR TO PROVIDE THE UNIT PRICE/TOTAL IN TEXT AS WELL AS NUMERICAL FORMAT FOR EACH LINE ITEM LISTED IN THE PROPOSAL BID FORMS. FAILURE TO PROVIDE UNIT PRICE/TOTAL FOR EACH LINE ITEM IN TEXT AS WELL AS NUMERICAL FORMAT MAY RENDER THE ENTIRE BID PACKAGE NON-RESPONSIVE.

4. THE CITY OF HOLLYWOOD WILL EVALUATE THE BID PROPOSALS AND DETERMINE THE LOWEST, RESPONSIVE, RESPONSIBLE BIDDER FOR THE TOTAL BASE BID. IT IS THE CITY OF HOLLYWOOD'S INTENT TO AWARD THE PROJECT BASED UPON THE TOTAL BASE BID.

ALTERNATE BID ITEMS

The following items are at the OWNER'S OPTION and shall not be included in the Total Base Bid, shall not affect the Contract Award, and shall not affect substantial and final completion time requirements.

Item No.	Estimated Quantity	Description	Unit Price	Extension or Total
A-1	Net Increase or Decrease versus Base Bid Total	Sectional CIPP Lining at RAS PS No. 1 (in lieu of stairs and wall pipe replacement with wall repair): <u>Fifteen Thousand</u> Dollars and <u>NO</u> Cents	--	\$ <u>15,000.00</u>
A-2	Net Increase versus Base Bid Total	Additional Instrumentation and Controls System Integration: <u>Sixteen Thousand Six Hundred</u> Dollars and <u>NO</u> Cents	--	\$ <u>16,600.00</u>
A-3	Net Increase versus Base Bid Total	Procure two (2) 24-inch Ball Valves and furnish to the City for Deep Injection Well No. 1: <u>One Hundred Thirty Thousand</u> Dollars and <u>NO</u> Cents	--	\$ <u>130,000.00</u>

- END OF SECTION -

SECTION 00410

APPROVED BID BOND

(Construction)

STATE OF FLORIDA

KNOW ALL MEN BY THESE PRESENTS:

That we Intercounty Engineering, Inc., as Principal, and ARCH Insurance Company as Surety, are held and firmly bound unto the City of Hollywood in the sum of _____
-- TEN PERCENT (10%) OF PROPOSED BID -- Dollars (\$ ---10%---) lawful money of the United States, amounting to 10% of the total Bid Price, for the payment of said sum, we bind ourselves, our heirs, executors, administrators, and successors, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION IS SUCH, that whereas the principal has submitted the accompanying bid, dated November 12, 2019 for

RAS PUMP STATION NO.1 REPLACEMENT
Project No. 17-9523

NOW, THEREFORE, if the principal shall not withdraw said bid within 90 days after date of the same and shall within ten days after the prescribed forms are presented to him for signature, enter into a written contract with the CITY, in accordance with the bid as accepted, and give bond with good and sufficient surety or sureties, and provide the necessary Insurance Certificates as may be required for the faithful performance and proper fulfillment of such Contract, then this obligation shall be null and void.

Approved Bid Bond

In the event of the withdrawal of said bid within the specified period, or the failure to enter into such contract and give such bond and insurance within the specified time, the principal and the surety shall pay to the City of Hollywood the difference between the amount specified in said bid and such larger amount for which the City of Hollywood may in good faith contract with another party to perform the work and/or supply the materials covered by said bid.

IN WITNESS WHEREOF, the above bound parties have executed this statement under their several seals this 12th
day of November, 2019, the name and corporate seal of each corporate party being hereto affixed and these presents duly signed by its undersigned representative, pursuant to authority of its governing body.

WHEN THE PRINCIPAL IS AN INDIVIDUAL: n/a

Signed, sealed and delivered in the presence of:

Witness

Signature of Individual

Address

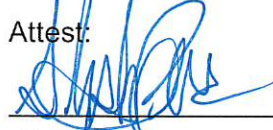
Printed Name of Individual

Witness

Address

WHEN THE PRINCIPAL IS A CORPORATION:

Attest:



Secretary

Intercounty Engineering, Inc.

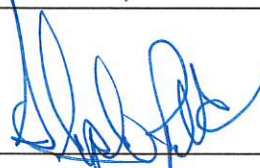
Name of Corporation

1925 NW 18 Street

Business Address

Pompano Beach, FL 33069

By:



(Affix Corporate Seal)

Stephen Polk

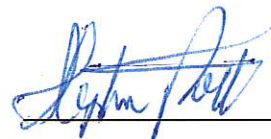
Printed Name

Vice President

Official Title

CERTIFICATE AS TO CORPORATE PRINCIPAL

I, Stephen Polk, certify that I am the secretary of the Corporation named as Principal in the attached bond; that Stephen Polk who signed the said bond on behalf of the Principal, was then Vice President of said Corporation; that I know his signature, and his signature thereto is genuine and that said bond was duly signed, sealed and attested for and on behalf of said Corporation by authority of its governing body.



(SEAL)

Secretary

TO BE EXECUTED BY CORPORATE SURETY:

Attest:

see attached power of attorney

Secretary

ARCH Insurance Company

Corporate Surety

Harborside 3, 210 Hudson Street, Suite 300

Business Address

JERSEY CITY, NJ 07311

BY: 

(Affix Corporate Seal)

Laura D. Mosholder, Attorney-In-Fact &

Florida Resident Agent, Inquiries: 407-330-3990

Attorney-in-Fact

Nielson, Mosholder & Associates

Name of Local Agency

4380 St. Johns Pkwy, Ste. 110

Business Address

Sanford, Florida 32771

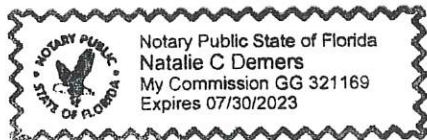
STATE OF FLORIDA


Before me, a Notary Public, duly commissioned, qualified and acting, personally appeared, ____

Laura D. Mosholder to me well known, who being by me first duly sworn upon oath says that he is the attorney-in-fact for the ARCH Insurance Company and

that the has been authorized by ARCH Insurance Company to execute the forgoing bond on behalf of the CONTRACTOR named therein in favor of the City of Hollywood, Florida.

Subscribed and sworn to before me this 12th day of November, 2019




Notary Public, State of Florida
Natalie C. Demers

My Commission Expires: **July 30, 2023**

- END OF SECTION -

THIS POWER OF ATTORNEY IS NOT VALID UNLESS IT IS PRINTED ON BLUE BACKGROUND.

This Power of Attorney limits the acts of those named herein, and they have no authority to bind the Company except in the manner and to the extent herein stated. Not valid for Note, Loan, Letter of Credit, Currency Rate, Interest Rate or Residential Value Guarantees.

POWER OF ATTORNEY

Know All Persons By These Presents

That the Arch Insurance Company, a corporation organized and existing under the laws of the State of Missouri, having its principal administrative office in Jersey City, New Jersey (hereinafter referred to as the "Company") does hereby appoint:

Brett Rosenhaus of Delray Beach, FL
 Charles D. Nielson, Charles J. Nielson and David R. Hoover of Miami Lakes, FL (EACH)
 F. Danny Gann, Edward T. Ward and Audria R. Ward of Atlanta, GA (EACH)
 John R. Neu and Kevin Wojtowicz of St. Petersburg, FL (EACH)
 Laura D. Mosholder of Orlando, FL

its true and lawful Attorney(s) in fact, to make, execute, seal, and deliver from the date of issuance of this power for and on its behalf as surety and as its act and deed:

Any and all bonds, undertakings, recognizances and other surety obligations, in the penal sum not exceeding Ninety Million Dollars (\$90,000,000.00).

This authority does not permit the same obligation to be split into two or more bonds in order to bring each such bond within the dollar limit of authority as set forth herein.

The execution of such bonds, undertakings, recognizances and other surety obligations in pursuance of these presents shall be as binding upon the said Company as fully and amply to all intents and purposes, as if the same had been duly executed and acknowledged by its regularly elected officers at its principal administrative office in Jersey City, New Jersey.

This Power of Attorney is executed by authority of resolutions adopted by unanimous consent of the Board of Directors of the Company on September 15, 2011, true and accurate copies of which are hereinafter set forth and are hereby certified to by the undersigned Secretary as being in full force and effect:

"VOTED, That the Chairman of the Board, the President, or the Executive Vice President, or any Senior Vice President, of the Surety Business Division, or their appointees designated in writing and filed with the Secretary, or the Secretary shall have the power and authority to appoint agents and attorneys-in-fact, and to authorize them subject to the limitations set forth in their respective powers of attorney, to execute on behalf of the Company, and attach the seal of the Company thereto, bonds, undertakings, recognizances and other surety obligations obligatory in the nature thereof, and any such officers of the Company may appoint agents for acceptance of process."

This Power of Attorney is signed, sealed and certified by facsimile under and by authority of the following resolution adopted by the unanimous consent of the Board of Directors of the Company on September 15, 2011:

VOTED, That the signature of the Chairman of the Board, the President, or the Executive Vice President, or any Senior Vice President, of the Surety Business Division, or their appointees designated in writing and filed with the Secretary, and the signature of the Secretary, the seal of the Company, and certifications by the Secretary, may be affixed by facsimile on any power of attorney or bond executed pursuant to the resolution adopted by the Board of Directors on September 15, 2011, and any such power so executed, sealed and certified with respect to any bond or undertaking to which it is attached, shall continue to be valid and binding upon the Company.

In Testimony Whereof, the Company has caused this instrument to be signed and its corporate seal to be affixed by the undersigned officers; this 20th day of August, 2019.

Kant Kopy® K1
Security Paper
• Hidden Pantograph
• Color Match
• Artificial Watermark
• Anti-Copy Coin Rub
• Measure Protection
• Security Features Box
• Microprint Protection
• Acid Free

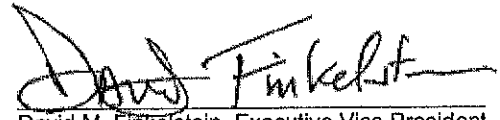
Kant Kopy® K1
Security Paper
• Hidden Pantograph
• Color Match
• Artificial Watermark
• Anti-Copy Coin Rub
• Measure Protection
• Security Features Box
• Microprint Protection
• Acid Free

Attested and Certified

Arch Insurance Company


Patrick K. Nails, Secretary

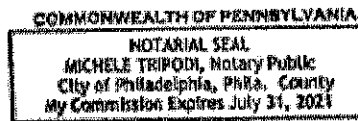




David M. Finkelstein, Executive Vice President

STATE OF PENNSYLVANIA SS

COUNTY OF PHILADELPHIA SS

I, Michele Tripodi, a Notary Public, do hereby certify that Patrick K. Nails and David M. Finkelstein personally known to me to be the same persons whose names are respectively as Secretary and Executive Vice President of the Arch Insurance Company, a Corporation organized and existing under the laws of the State of Missouri, subscribed to the foregoing instrument, appeared before me this day in person and severally acknowledged that they being thereunto duly authorized signed, sealed with the corporate seal and delivered the said instrument as the free and voluntary act of said corporation and as their own free and voluntary acts for the uses and purposes therein set forth.




Michele Tripodi, Notary Public
My commission expires 07/31/2021

CERTIFICATION

I, Patrick K. Nails, Secretary of the Arch Insurance Company, do hereby certify that the attached Power of Attorney dated August 20, 2019 on behalf of the person(s) as listed above, is true and correct copy and that the same has been in full force and effect since the date thereof and is in full force and effect on the date of this certificate; and I do further certify that the said David M. Finkelstein executed the Power of Attorney as Executive Vice President, was on the date of execution of the attached Power of Attorney the elected Executive Vice President of the Arch Insurance Company.

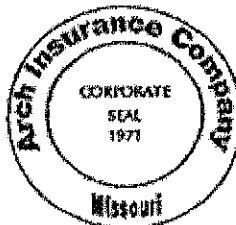
IN TESTIMONY WHEREOF, I have hereunto set my hand and affixed the corporate seal of the Arch Insurance Company this 12th day of November, 2019.


Patrick K. Nails, Secretary

This Power of Attorney limits the acts of those named therein to the bonds and undertakings specifically named therein and they have no authority to bind the Company except in the manner and to the extent herein stated.

PLEASE SEND ALL CLAIM INQUIRIES RELATING TO THIS BOND TO THE FOLLOWING ADDRESS:

Arch Insurance – Surety Division
3 Parkway, Suite 1500
Philadelphia, PA 19102



SECTION 00420

INFORMATION REQUIRED FROM BIDDERS

GENERAL INFORMATION

The Bidder shall furnish the following information. Failure to comply with this requirement may cause its rejection. Additional sheets shall be attached as required.

1. Contractor's Name/Address: Intercounty Engineering, Inc.
1925 NW 18 Street
Pompano Beach, FL 33069
2. Contractor's Telephone Number: (954) 972-9800
and e-mail address: bids@rfcenvironmental.com
3. Contractor's License (attach copy): CGC 1528089 / CUC 1225605
Primary Classification: State Certified General Contractor/ State Certified Underground Utility/Excavation
Broward County License Number (attach copy): _____
4. Number of years as a Contractor in construction work of the type involved in this Contract: 25 years
5. List the names and titles of all officers of Contractor's firm:
Jeff Condello - P-S-T

6. Name of person who inspected site or proposed work for your firm:
Name: Eric Jones - General Manager
Date of Inspection: 10/22/19

7. What is the last project of this nature you have completed?

See attached Completed Projects

8. Have you ever failed to complete work awarded to you; if so, where and why?

No

9. Name three individuals or corporations for which you have performed work and to which you refer:

See attached Completed Projects

10. List the following information concerning all contracts on hand as of the date of submission of this proposal (in case of co-venture, list the information for all co-ventures).

Name of Project	City	Total Contract Value	Contracted Date of Completion	% Completion to Date
-----------------	------	----------------------------	-------------------------------------	----------------------------

See Attached Jobs in Progress

(Continue list on inset sheet, if necessary)

11. What equipment do you own that is available for the work?

See Attached Equipment List

12. What equipment will you purchase for the proposed work?

None.

NOTE:

If requested by CITY, the Bidder shall furnish a notarized financial statement, references and other information, sufficiently comprehensive to permit an appraisal of its current financial condition.

LIST OF SUBCONTRACTORS

The Bidder shall list below the name and address of each Subcontractor who will perform work under this Contract in excess of one-half percent of the total bid price, and shall also list the portion of the work which will be done by such Subcontractor. After the opening of Proposals, changes or substitutions will be allowed with written approval of the City of Hollywood. Subcontractors must be properly licensed and hold a valid Hollywood Certificate of Competency. Contractor shall choose one of the two Subcontractors for System Integration listed below, per Section 17000, Part 1.04(B).

	Work to be Performed	Subcontractor's Name / Address
1.	System Integration <u>(Circle One / Strikethrough Other)</u>	CC Control Corporation Curry Controls Company
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		

NOTE: Attach additional sheets if required.

- END OF SECTION -

SECTION 00435

LOCAL PREFERENCE (EXHIBIT "A")

Pursuant to §38.50 of the City of Hollywood Code of Ordinances, the City shall grant a preference to local Hollywood vendors if their initial bid is within 5% of the bid of the lowest responsive responsible bidder that is a non-local Hollywood vendor. The preference shall allow the local Hollywood vendor to submit a second and final offer, which must be at least 1% less than the bid of the lowest responsive responsive non-local Hollywood vendor to be awarded. The local Hollywood vendor shall have the burden of demonstrating that it maintains a permanent place of business with full-time employees within the City limits and has done so for a minimum of one (1) year prior to the date of issuance of a bid or proposal solicitation within Hollywood, Florida. All supporting documentation (e.g. City of Hollywood valid local business tax receipt) for local preference eligibility must be received with the bid package prior to the bid opening date and time.

- END OF SECTION -

SECTION 00495

TRENCH SAFETY FORM

This form must be completed and signed by the Bidder.

Failure to complete this form may result in the bid being declared non-responsive.

Bidder acknowledges that the Florida Trench Safety Act, Section 553.60 et. seq., which became effective October 1, 1990, shall be in effect during the period of construction of the project. The Bidder by signing and submitting the bid is, in writing, assuring that it will perform any trench excavation in accordance with applicable trench safety standards. The Bidder further identifies the following separate item of cost of compliance with the applicable trench safety standards as well as the method of compliance:

Method of Compliance

Cost

Barricades

Total \$ 500.00

Bidder acknowledges that this cost is included in the applicable items of the Proposal and in the Grand Total Bid Price. Failure to complete the above will result in the bid being declared non-responsive.

The Bidder is, and the Owner and Engineer are not, responsible to review or assess Bidder'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 any and all requirements of Florida Statute Section 553.60 et. seq. cited as the "Trench Safety Act". Bidder is, and the owner and Engineer are not, responsible to determine if any safety related standards apply to the project, including but not limited to, the "Trench Safety Act".



Witness Signature

Shelley McDougale

Witness Printed Name

1925 NW 18 St., Pompano, FL 33069

Witness Address

11/12/19

Date



Contractor's Signature

Stephen Polk

Printed Name

Vice President

Title

11/12/19

Date

- END OF SECTION -

State of Florida

Department of State

I certify from the records of this office that INTERCOUNTY ENGINEERING INC. is a corporation organized under the laws of the State of Florida, filed on June 1, 1994.

The document number of this corporation is P94000041435.

I further certify that said corporation has paid all fees due this office through December 31, 2019, that its most recent annual report/uniform business report was filed on January 31, 2019, and that its status is active.

I further certify that said corporation has not filed Articles of Dissolution.

*Given under my hand and the
Great Seal of the State of Florida
at Tallahassee, the Capital, this
the Thirty-first day of January,
2019*



Jennifer Kenney
Secretary of State

Tracking Number: 3936957075CC

To authenticate this certificate, visit the following site, enter this number, and then follow the instructions displayed.

<https://services.sunbiz.org/Filings/CertificateOfStatus/CertificateAuthentication>



Intercounty Engineering, Inc.
1925 NW 18th Street
Pompano Beach, FL 33069

INTERCOUNTY ENGINEERING, INC. AUTHORIZATION LETTER

RE: COMPANY SIGNATURE AUTHORIZATION

Jeffrey Condello, Owner/President of Intercounty Engineering, Inc. authorizes Stephen Polk, Vice President, to sign all bidding documents.

President: Jeffrey Condello – Intercounty Engineering, Inc.

Signature: _____

A handwritten signature, likely of Jeffrey Condello, is written over a horizontal line. The signature is stylized and cursive.

Date: 4/9/2019

Request for Taxpayer Identification Number and Certification

Give Form to the
requester. Do not
send to the IRS.

► Go to www.irs.gov/FormW9 for instructions and the latest information.

Print or type.
See Specific Instructions on page 3.

1 Name (as shown on your income tax return). Name is required on this line; do not leave this line blank. Intercounty Engineering, Inc.	
2 Business name/disregarded entity name, if different from above	
3 Check appropriate box for federal tax classification of the person whose name is entered on line 1. Check only one of the following seven boxes. <input type="checkbox"/> Individual/sole proprietor or single-member LLC <input checked="" type="checkbox"/> C Corporation <input type="checkbox"/> S Corporation <input type="checkbox"/> Partnership <input type="checkbox"/> Trust/estate <input type="checkbox"/> Limited liability company. Enter the tax classification (C=C corporation, S=S corporation, P=Partnership) ► Note: Check the appropriate box in the line above for the tax classification of the single-member owner. Do not check LLC if the LLC is classified as a single-member LLC that is disregarded from the owner unless the owner of the LLC is another LLC that is not disregarded from the owner for U.S. federal tax purposes. Otherwise, a single-member LLC that is disregarded from the owner should check the appropriate box for the tax classification of its owner. <input type="checkbox"/> Other (see instructions) ►	4 Exemptions (codes apply only to certain entities, not individuals; see instructions on page 3): Exempt payee code (if any) _____ Exemption from FATCA reporting code (if any) _____ (Applies to accounts maintained outside the U.S.)
5 Address (number, street, and apt. or suite no.) See instructions. 1925 NW 18 Street	Requester's name and address (optional)
6 City, state, and ZIP code Pompano Beach, FL 33069	
7 List account number(s) here (optional)	

Part I Taxpayer Identification Number (TIN)

Enter your TIN in the appropriate box. The TIN provided must match the name given on line 1 to avoid backup withholding. For individuals, this is generally your social security number (SSN). However, for a resident alien, sole proprietor, or disregarded entity, see the instructions for Part I, later. For other entities, it is your employer identification number (EIN). If you do not have a number, see *How to get a TIN*, later.

Note: If the account is in more than one name, see the instructions for line 1. Also see *What Name and Number To Give the Requester* for guidelines on whose number to enter.

Social security number								
			-				-	
or								
Employer identification number								
6	5	-	0	4	9	5	3	3

Part II Certification

Under penalties of perjury, I certify that:

- The number shown on this form is my correct taxpayer identification number (or I am waiting for a number to be issued to me); and
- I am not subject to backup withholding because: (a) I am exempt from backup withholding, or (b) I have not been notified by the Internal Revenue Service (IRS) that I am subject to backup withholding as a result of a failure to report all interest or dividends, or (c) the IRS has notified me that I am no longer subject to backup withholding; and
- I am a U.S. citizen or other U.S. person (defined below); and
- The FATCA code(s) entered on this form (if any) indicating that I am exempt from FATCA reporting is correct.

Certification instructions. You must cross out item 2 above if you have been notified by the IRS that you are currently subject to backup withholding because you have failed to report all interest and dividends on your tax return. For real estate transactions, item 2 does not apply. For mortgage interest paid, acquisition or abandonment of secured property, cancellation of debt, contributions to an individual retirement arrangement (IRA), and generally, payments other than interest and dividends, you are not required to sign the certification, but you must provide your correct TIN. See the instructions for Part II, later.

Sign Here	Signature of U.S. person ► 	Date ► 09/19/19
------------------	--	------------------------

General Instructions

Section references are to the Internal Revenue Code unless otherwise noted.

Future developments. For the latest information about developments related to Form W-9 and its instructions, such as legislation enacted after they were published, go to www.irs.gov/FormW9.

Purpose of Form

An individual or entity (Form W-9 requester) who is required to file an information return with the IRS must obtain your correct taxpayer identification number (TIN) which may be your social security number (SSN), individual taxpayer identification number (ITIN), adoption taxpayer identification number (ATIN), or employer identification number (EIN), to report on an information return the amount paid to you, or other amount reportable on an information return. Examples of information returns include, but are not limited to, the following.

- Form 1099-INT (interest earned or paid)

- Form 1099-DIV (dividends, including those from stocks or mutual funds)
- Form 1099-MISC (various types of income, prizes, awards, or gross proceeds)
- Form 1099-B (stock or mutual fund sales and certain other transactions by brokers)
- Form 1099-S (proceeds from real estate transactions)
- Form 1099-K (merchant card and third party network transactions)
- Form 1098 (home mortgage interest), 1098-E (student loan interest), 1098-T (tuition)
- Form 1099-C (canceled debt)
- Form 1099-A (acquisition or abandonment of secured property)

Use Form W-9 only if you are a U.S. person (including a resident alien), to provide your correct TIN.

If you do not return Form W-9 to the requester with a TIN, you might be subject to backup withholding. See *What is backup withholding*, later.



INTERCOUNTY ENGINEERING, INC.
1925 NW 18TH STREET
POMPANO BEACH, FL 33069
TEL: (954) 972-9800 FAX: (954) 974-0042

Equipment List

GEHL SWEEPSTER BROOM
GEHL LOADER
200Lf x 25' SHEET PILING C27
GENERATOR GENAC
20' STORAGE CONTAINER
1998 544H JD WHEEL LOADER
COMPRESSOR
20' STORAGE CONTAINER
20' STORAGE CONTAINER
20' STORAGE CONTAINER
20' STORAGE CONTAINER
MWI 4 HYD SUBMS"
CONCRETE VIBRATOR/NEFF
1997 CASE EXCAVATOR 9060B
MCDONALD PUMP
KOMATSU PC130-6 1998 EXC
VOLVO L70C LOADER 1995
MUSTANG EXC 1999
ALLIS CHAMBERS GRADER
KOMATSU PC 220LC EXC
2001 PUCKETT ASPHALT PAVER
WACKER COMPACTOR
INGERSOLL-RAND DA30 TANDEM ROLLER
6" JET PUMP GORMAN-RUPP PUMP
36 BUCKET
60 DITCHING BUCKET
42 BUCKET
375 CR SULLAIR PORTABLE AIR COMPRESSOR
KOMATSU WA 180 LOADER
WACKER, COMPACTOR
DYNAPAC LF90 COMPACTOR
KAI-WLK-15 LOADER
BOBCAST SKID STEER LOADER
POWERTRAIN AIR COMPRESSOR
2000 CASE 9050B HYD EXCAVATOR

KOMATSU PC55UU MINI EXCAVATOR
KAWASI 652II LOADER
SKIDSTEER LOADER BROOM ATTACHMT
VERSATECH GRAPPLE BUCKET
DENYO GENERATOR
HONDA PUMP
5 HYDRAULIC GRAPPLE ATTACH
GENERATOR
HONDA WATER PUMP
35 TON NORTHWEST CRANE
HYSTER 5 TON ASPHALT ROLLER
DENYO WELDER
MUELLER TAP DRILL MACHINE
12 HEAVY DUTY MUSTANG BUCKET
MUELLER B101 TAPPING MACH
BOB CAT MILLER HEAD
12' CORAL ROCK BUCKET
12" Bucket Fork for Komatsu 55uu
24" Bucket for Mustang Exc
52 Grading Bucket
MANHOLE BOX #6
1998 UPRIGHT SCISSOR LIFT
Q/C FORKS
IBH SDR 1400 VIB ROLLER 7 to 10 TON
MOTOR GRADER
1/2 YARD HYD CLAM BUCKET
60+ STEEL PLATES 8'X20'
7 YD ROCK BOX
THOMPSON 6"JET PUMP W/DUTZE AIR COOLED ENGINE
KOMATSU 140WB LOADER/BACKHOE
2004 Cat 257 Multi-Terrain Loader
10 TON RAY GO STEEL DRUM ROLLER
CAT FORK ATTACHMENT
BRADCO FORK ATTACHMENT
1998 HYUNDAL 55-3 HYD EXCAVATOR

WB FORK ATTACHMENT
WB 36" DIGGING BUCKET
ESCO 28" DIGGING BUCKET
12 Thompson 12" Wellpoint Pump
6 Thompson Hydraulic Submers Pump
4 Thompson Hydraulic Submers Pump
STEEL ROAD PLATES
STEEL ROAD PLATES
INGERSOLL RAND COMPRESSOR
MANHOLE BOX
2007 ATIMA DIESEL WELDER
1997 Moffett 5000 Forklift
Wellpoint System
Trenchbox 8'X24'
(2) 6'X12' Steel Plates
(1) 4'X8' Steel Plates
(52) 8'X20' Steel Plates
(6) 6'X10' Steel Plates
(14) 8'X10' Steel Plates
(10) 8'X12' Steel Plates



RANDMEC-02

KELSONM

CERTIFICATE OF LIABILITY INSURANCE

DATE (MM/DD/YYYY)

10/11/2019

THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER. THIS CERTIFICATE DOES NOT AFFIRMATIVELY OR NEGATIVELY AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES BELOW. THIS CERTIFICATE OF INSURANCE DOES NOT CONSTITUTE A CONTRACT BETWEEN THE ISSUING INSURER(S), AUTHORIZED REPRESENTATIVE OR PRODUCER, AND THE CERTIFICATE HOLDER.

IMPORTANT: If the certificate holder is an **ADDITIONAL INSURED**, the policy(ies) must have **ADDITIONAL INSURED** provisions or be endorsed. If **SUBROGATION IS WAIVED**, subject to the terms and conditions of the policy, certain policies may require an endorsement. A statement on this certificate does not confer rights to the certificate holder in lieu of such endorsement(s).

PRODUCER Insurance Office of America, Inc. 1855 West State Road 434 Longwood, FL 32750	CONTACT NAME:	
	PHONE (A/C, No, Ext): (800) 243-8899	FAX (A/C, No): (407) 788-7933
INSURED Intercounty Engineering Inc. 1925 NW 18th St Pompano Beach, FL 33069	E-MAIL ADDRESS:	
	INSURER(S) AFFORDING COVERAGE	
	INSURER A: Continental Casualty Company	
	INSURER B: Westchester Surplus Lines Insurance Company	
	INSURER C:	
	INSURER D:	
INSURER E:		
INSURER F:		

COVERAGES

CERTIFICATE NUMBER:

REVISION NUMBER:

THIS IS TO CERTIFY THAT THE POLICIES OF INSURANCE LISTED BELOW HAVE BEEN ISSUED TO THE INSURED NAMED ABOVE FOR THE POLICY PERIOD INDICATED. NOTWITHSTANDING ANY REQUIREMENT, TERM OR CONDITION OF ANY CONTRACT OR OTHER DOCUMENT WITH RESPECT TO WHICH THIS CERTIFICATE MAY BE ISSUED OR MAY PERTAIN, THE INSURANCE AFFORDED BY THE POLICIES DESCRIBED HEREIN IS SUBJECT TO ALL THE TERMS, EXCLUSIONS AND CONDITIONS OF SUCH POLICIES. LIMITS SHOWN MAY HAVE BEEN REDUCED BY PAID CLAIMS.

INSR LTR	TYPE OF INSURANCE	ADDL INSD	SUBR WVD	POLICY NUMBER	POLICY EFF (MM/DD/YYYY)	POLICY EXP (MM/DD/YYYY)								
A	<input checked="" type="checkbox"/> COMMERCIAL GENERAL LIABILITY <input type="checkbox"/> CLAIMS-MADE <input checked="" type="checkbox"/> OCCUR GEN'L AGGREGATE LIMIT APPLIES PER: <input type="checkbox"/> POLICY <input checked="" type="checkbox"/> PROJECT <input type="checkbox"/> LOC OTHER:			CPM6079015233	10/15/2019	10/15/2020	EACH OCCURRENCE \$ 1,000,000							
							DAMAGE TO RENTED PREMISES (Ea occurrence) \$ 500,000							
							MED EXP (Any one person) \$ 15,000							
							PERSONAL & ADV INJURY \$ 1,000,000							
							\$ 2,000,000							
							PRODUCTS - COMP/OP AGG \$ 2,000,000							
							Limited Pollut. \$ 1,000,000							
							COMBINED SINGLE LIMIT (Ea accident) \$ 1,000,000							
							BODILY INJURY (Per person) \$							
							BODILY INJURY (Per accident) \$							
PROPERTY DAMAGE (Per accident) \$														
							\$							
A	<input checked="" type="checkbox"/> AUTOMOBILE LIABILITY <input checked="" type="checkbox"/> ANY AUTO OWNED AUTOS ONLY <input type="checkbox"/> SCHEDULED AUTOS <input type="checkbox"/> HIRED AUTOS ONLY <input type="checkbox"/> NON-OWNED AUTOS ONLY			BUA6079015250	10/15/2019	10/15/2020	BODILY INJURY (Per person) \$							
							BODILY INJURY (Per accident) \$							
							PROPERTY DAMAGE (Per accident) \$							
							\$							
														\$
							A	<input checked="" type="checkbox"/> UMBRELLA LIAB <input checked="" type="checkbox"/> EXCESS LIAB DED <input checked="" type="checkbox"/> RETENTION \$ 10,000			CUE6079015264	10/15/2019	10/15/2020	EACH OCCURRENCE \$ 9,000,000
														AGGREGATE \$
														Aggregate \$ 9,000,000
														PER STATUTE <input type="checkbox"/> OTH-ER <input type="checkbox"/>
														E.L. EACH ACCIDENT \$
E.L. DISEASE - EA EMPLOYEE \$														
E.L. DISEASE - POLICY LIMIT \$														
														\$
														\$
														\$
B	WORKERS COMPENSATION AND EMPLOYERS' LIABILITY ANY PROPRIETOR/PARTNER/EXECUTIVE OFFICER/MEMBER EXCLUDED? (Mandatory in NH) <input type="checkbox"/> Y/N If yes, describe under DESCRIPTION OF OPERATIONS below			G70920256001	2/7/2019	2/5/2020	Limit \$ 5,000,000							

DESCRIPTION OF OPERATIONS / LOCATIONS / VEHICLES (ACORD 101, Additional Remarks Schedule, may be attached if more space is required)
Pollution Liability limit increased to \$5,000,000 and Umbrella Liability limit increased to \$9,000,000 effective 6/28/2019.

CERTIFICATE HOLDER

CANCELLATION

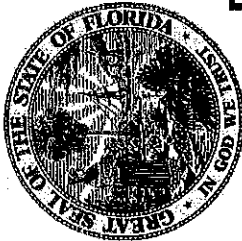
SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, NOTICE WILL BE DELIVERED IN ACCORDANCE WITH THE POLICY PROVISIONS.

AUTHORIZED REPRESENTATIVE

*****SAMPLE*****

CERTIFICATE OF LIABILITY INSURANCE							Date 2/6/2019	
Producer: Plymouth Insurance Agency 2739 U.S. Highway 19 N. Holiday, FL 34691 (727) 938-5562				This Certificate is issued as a matter of information only and confers no rights upon the Certificate Holder. This Certificate does not amend, extend or alter the coverage afforded by the policies below.				
Insured: South East Personnel Leasing, Inc. & Subsidiaries 2739 U.S. Highway 19 N. Holiday, FL 34691				Insurers Affording Coverage Insurer A: Lion Insurance Company Insurer B: Insurer C: Insurer D: Insurer E:			NAIC # 11075	
Coverages <small>The policies of insurance listed below have been issued to the insured named above for the policy period indicated. Notwithstanding any requirement, term or condition of any contract or other document with respect to which this certificate may be issued or may pertain, the insurance afforded by the policies described herein is subject to all the terms, exclusions, and conditions of such policies. Aggregate limits shown may have been reduced by paid claims.</small>								
INSR LTR	ADDL INSRD	Type of Insurance	Policy Number	Policy Effective Date (MM/DD/YY)	Policy Expiration Date (MM/DD/YY)	Limits		
		GENERAL LIABILITY <input type="checkbox"/> Commercial General Liability <input type="checkbox"/> Claims Made <input type="checkbox"/> Occur General aggregate limit applies per: <input type="checkbox"/> Policy <input type="checkbox"/> Project <input type="checkbox"/> LOC				Each Occurrence		
		AUTOMOBILE LIABILITY <input type="checkbox"/> Any Auto <input type="checkbox"/> All Owned Autos <input type="checkbox"/> Scheduled Autos <input type="checkbox"/> Hired Autos <input type="checkbox"/> Non-Owned Autos				Damage to rented premises (EA occurrence)		
		EXCESS/UMBRELLA LIABILITY <input type="checkbox"/> Occur <input type="checkbox"/> Claims Made <input type="checkbox"/> Deductible				Mod Exp		
						Personal Adv Injury		
						General Aggregate		
						Products - Comp/Op Agg		
						Combined Single Limit (EA Accident)		
						Bodily Injury (Per Person)		
						Bodily Injury (Per Accident)		
						Property Damage (Per Accident)		
						Each Occurrence		
						Aggregate		
A		Workers Compensation and Employers' Liability Any proprietor/partner/executive officer/member excluded? NO If Yes, describe under special provisions below.	WC 71949	01/01/2019	01/01/2020	X	WC Statutory Limits	OTH-ER
							E.L. Each Accident	\$1,000,000
							E.L. Disease - Ea Employee	\$1,000,000
							E.L. Disease - Policy Limits	\$1,000,000
Other			Lion Insurance Company is A.M. Best Company rated A (Excellent). AMB # 12616					
Descriptions of Operations/Locations/Vehicles/Exclusions added by Endorsement/Special Provisions:								
Client ID: 91-67-608 Coverage only applies to active employee(s) of South East Personnel Leasing, Inc. & Subsidiaries that are leased to the following "Client Company": <p style="text-align: center;">Intercounty Engineering, Inc.</p> Coverage only applies to injuries incurred by South East Personnel Leasing, Inc. & Subsidiaries active employee(s), while working in: FL. Coverage does not apply to statutory employee(s) or independent contractor(s) of the Client Company or any other entity. A list of the active employee(s) leased to the Client Company can be obtained by faxing a request to (727) 937-2138 or email certificates@lioninsurancecompany.com								
Project Name: WAIVER OF SUBROGATION APPLIES IN FAVOR OF								
ON. ISSUE 08-30-18 (KLR). REISSUE 02-06-19 (KLR)								
CERTIFICATE HOLDER				CANCELLATION Should any of the above described policies be cancelled before the expiration date thereof, the issuing insurer will endeavor to mail 30 days written notice to the certificate holder named to the left, but failure to do so shall impose no obligation or liability of any kind upon the insurer, its agents or representatives.				

Ron DeSantis, Governor



Halsey Beshears, Secretary



STATE OF FLORIDA
DEPARTMENT OF BUSINESS AND PROFESSIONAL REGULATION

CONSTRUCTION INDUSTRY LICENSING BOARD

THE GENERAL CONTRACTOR HEREIN IS CERTIFIED UNDER THE
PROVISIONS OF CHAPTER 489, FLORIDA STATUTES



LICENSE NUMBER CGC1528089

EXPIRATION DATE: AUGUST 31, 2020

Always verify licenses online at MyFloridaLicense.com



Do not alter this document in any form.

This is your license. It is unlawful for anyone other than the licensee to use this document.

Ron DeSantis, Governor



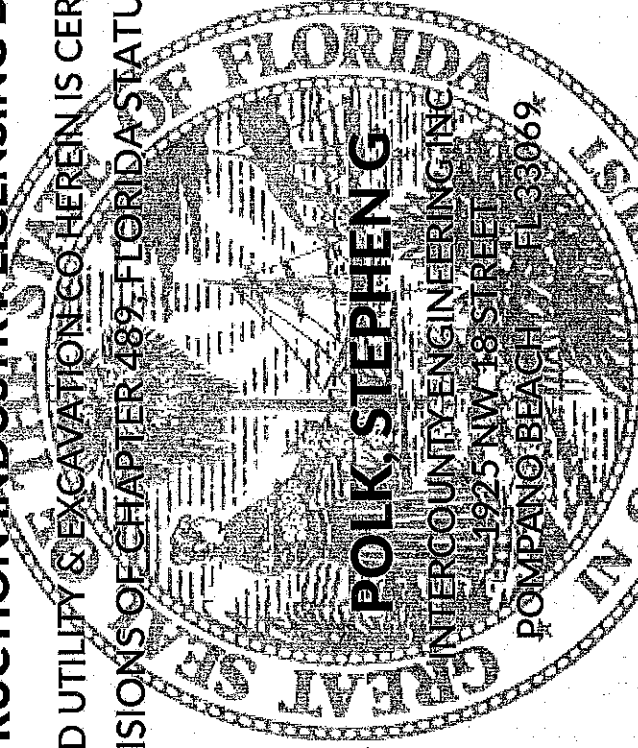
Halsey Beshears, Secretary



STATE OF FLORIDA
DEPARTMENT OF BUSINESS AND PROFESSIONAL REGULATION

CONSTRUCTION INDUSTRY LICENSING BOARD

THE UNDERGROUND UTILITY & EXCAVATION CO. HEREIN IS CERTIFIED UNDER THE
PROVISIONS OF CHAPTER 489, FLORIDA STATUTES



LICENSE NUMBER: CUC1225605

EXPIRATION DATE: AUGUST 31, 2020

Always verify licenses online at MyFloridaLicense.com



Do not alter this document in any form.

This is your license. It is unlawful for anyone other than the licensee to use this document.

INTERCOUNTY ENGINEERING, INC. - JOBS IN PROGRESS					
Project	Description	Owner	Engineer	Amount w/CO's	
18-200	Retail Wastewater Meter M-471	Broward County Water & Wastewater	Craven & Thompson	\$ 1,494,997.00	
	Site preparation, earthwork, excavation, pavement restoration, wastewater meter replacement, concrete vault replacement, force main cleaning and replacement within existing easements and the ROW of Powerline Road.	2555 Copans Road	3563 NW 53 Street	\$ -	
		Pompano Beach, FL 33069	Fort Lauderdale, FL 33309	\$ 1,494,997.00	
		Luz Sanchez	Gary Tenn P.E.		Completion Dates
		(954) 831-0971	(954) 739-6400		10/18 - 01/20
		LUSANCHEZ@broward.org	Stenn@craventhompson.com		
Project 18-300	Hollywood Lift Station A-5 Upgrade	City of Hollywood	Engineer	Amount w/CO's	
	Demolish and remove/convert existing can-type pump station to new	1621 N. 14th Ave	AECOM	\$ 997,356.00	
	submersible pump station including new wet well, valve chamber and flow meter access structure. Installation of pumps with VFD's, controls electrical and instrumentation.	Hollywood, Florida 33022	800 Douglas Entrance Suite 200	\$ -	
		Feng (Jeff) Jiang, P.E.	Miami, FL 33134	\$ 997,356.00	
		(954) 924-3930	Sheldon Barnes		Completion Dates
		FIANG@hollywoodfl.org	(305) 704-6429		04/19 - 04/20
Project 18-400	Boca Lift Station Rehabilitation & Repairs	City of Boca Raton Utilities	Engineer	Amount w/CO's	
	Continuing term contract for furnishing labor, materials, equipment, services and incidentals for the on-going rehab, repairs and replacement services to the City's lift station system. Site improvements including civil mechanical, electrical and all incidentals required.	1401 Glades Road	City of Boca Raton Utilities	\$ 1,200,000.00	
		Boca Raton, FL 33431	1401 Glades Road	\$ 0	
		Lisa Wilson-Davis P.E.	Boca Raton, FL 33431	\$ 1,200,000.00	
		(561) 338-7329	Lisa Wilson-Davis P.E.		Completion Dates
		LWilsonDavis@ci.boca-raton.fl.us	(561) 338-7329		09/18 - 9/21
Project 19-100	Master Pump Station 224	Broward County Water & Wastewater	Engineer	Amount w/CO's	
	Demo of interior piping, valves, wet well, valve vault, meter vault, electrical equipment, emergency pump out and piping, 24" influent valve and above ground operator and curb. Installation of new submersible pumps with required appurtenances, new trough frame, pedestrian, double access door cover, hatches, above ground piping, fittings, valves, pressure gauges flow meter, lining for influent pipe with above ground operator, reinforced concrete slab and valve bank, bypass connection, connection to existing force main, new odor control system, electric, telemetry, meter and install of pave drain system. Relocation of tress and site restoration.	Engineering Division	Craven & Thompson	\$ 1,590,332.00	
		2555 W. Copans Road	3563 NW 53 Street	\$ -	
		Pompano Beach, FL 33069	Fort Lauderdale, FL 33309	\$ 1,590,332.00	
		Vilma Melendez P.E.	Gary Tenn P.E.		Completion Dates
		(954) 831-3288	(954) 739-6400		05/19 - 05/20
		vmelendez@broward.org	Stenn@craventhompson.com		
Project 19-200	48-inch Finished Water Meter & Vault Replacement	City of West Palm Beach	Engineer	Amount w/CO's	
	Demo existing meter vault and Venturi meter, replacing both. Precast vault with double access door, access ladder, sump pump and convenience receptacle. New magnetic meter, electrical, instrumentation and controls.	401 Clematis Street	Jacobs Engineering	\$ 586,700.00	
		West Palm Beach, FL 33401	3300 PGA Boulevard Suite 780	\$ -	
		Jay Kwag, P.E.	Palm Beach Gardens, FL 33410	\$ 586,700.00	
		HJKwag@wpb.org	(561) 799-3655		Completion Dates
			Rudy Fernandez, P.E.		06/19 - 01/20
			Rudy.Fernandez@jacobs.com		
Project 19-300	Pembroke Pines Lift Station Rehabilitation & Repairs	City of Pembroke Pines	Engineer	Amount w/CO's	
	Continuing term contract for furnishing labor, materials, equipment, services and incidentals for the on-going rehab, repairs and replacement services to the City's lift station system. Site improvements including civil mechanical, electrical and all incidentals required.	8300 S. Palm Drive	Jacobs Engineering	\$ 580,000.00	
		Pembroke Pines, FL 33025	13975 Pembroke Road	\$ -	
		Paul Thompson	Pembroke Pines, FL 33027	\$ 580,000.00	
		(954) 518-9087	Ron Abel, Project Director		Completion Dates
		pthompson@ppines.com	(321) 288-0087		06/19 - 06/21
			Ron.Abel@jacobs.com		

Project	Description	Owner	Engineer	Amount w/CO's
19-702	Little Wekiva River Erosion Control & Countermeasures Contract includes nine (9) site packages, work within the river and on the river banks located between SR 436 on the west and East of Montgomery Road on the east. Work includes grading, excavation, construction of cofferdams, gabion blankets and baskets, placement of rip-rap, sheet piles and pile caps, site restoration and drainage system repairs.	City of Altamonte Springs 225 Newburyport Avenue Altamonte Springs, FL 32701 Lone "Trey" Sisk, PM (407) 571-8572 tsisk@altamonte.org	Sites 1-3 - VHB Bruce Dalg - (407) 839-4006 Site 4 - CDM Smith J. Williams - (407) 660-2552	\$ 2,313,267.43 \$ - \$ 2,313,267.43 Completion Dates Awaiting NTP
19-803	SW 08 & SW 09 Valve Replacement Replacement of two (2) 30" check valves, two (2) knife gate valves at PS 08, replacement of one (1) 36" flap gate (check valve) at PS 09.	City of Hollywood 1621 N. 14th Ave Hollywood, Florida 33022 (954) 921-3930	Engineer City of Hollywood 1621 N. 14th Ave Hollywood, Florida 33022 (954) 921-3930	\$ 387,465.00 \$ - \$ 387,465.00 Completion Dates Awaiting NTP
19-804	Lift Station 26, 45 & 51 Rehabilitation Demo of interior piping, valves, wet wells, pumps and electrical equipment all three (3) stations. Installation of new submersible pumps, piping, valves, electrical components and concrete structures. Site Improvements.	City of West Palm Beach 401 Clematis Street West Palm Beach, FL 33401 (561) 822-2100	Engineer Mathews Consulting 477 S. Rosemary Ave., Suite 330 West Palm Beach, FL 33401 Aaron Cutler, Vice President (561) 655-6175, Ext. 7714 acutler@baxterwoodman.com	\$ 3,522,466.00 \$ - \$ 3,522,466.00 Completion Dates Awaiting NTP
19-706	Lake Apopka North Shore Phase IV Pump Station Construction of a canal transfer pump station with two (2) 50 HP angled line shaft, axial flow pumps, 30" welded steel piping, fittings, valves, pump supports and pilings, platform structure and pilings, concrete sump pump and sheet piling and all associated electrical, instrumentation and controls. Site work improvements including grading, pre-engineered canopy, concrete pad and roadway, Chain link fencing and sodding.	St Johns River Water Management District 4049 Reid Street Palatka, FL 32178 (386) 329-4500	Engineer Reiss Engineering, Inc. 1016 Spring Villas Pt. Winter Springs, FL 32708 (407) 679-5358	\$ 1,319,700.00 \$ - \$ 1,319,700.00 Completion Dates Awaiting NTP
19-709	Town Center PS 3497 & South Central PS 3499 Master Pump Station PS 3497: Replacement of three (3) new wastewater submersible pumps, new wet well with coatings, install 100 ft of 20" force main including fittings, valves to existing force main. Concrete driveway, swing access gate, removal of chain link fence with 8' ft CMU wall w/gate. Demo existing valve vault, piping, valves and emergency pump out. Replace wet well top slab and access hatches, new electrical and control panels. Update existing SCADA system and remove and replace emergency standby generator. PS 3499: Decommission, demolition and abandon existing wet well, pumps, piping, buildings, slabs and equipment. Reconfigure incoming gravity sewer main and incoming and outgoing force mains. Dual chamber wet well with six (6) new wastewater submersible pumps and two (2) new mixers. Install new emergency standby generator and fuel storage tank. Construction of new electrical building including electrical, switchinggear, control panels, SCADA and HVAC system. Flow meter, biofilter and odor control system. Site restoration including water mains, water meters, backflow device, fire hydrants, block wall, driveway, stormwater ponds, concrete site interior, sliding gates, site grading, landscaping and irrigation.	Orange County Utilities 9150 Curry Ford Road Orlando, FL 32825 (407) 836-5515	Engineer Tetra Tech Inc. 201 E Pine Street #1000 Orlando, FL 32801 (407) 839-3955	\$ 9,719,700.00 \$ - \$ 9,719,700.00 Completion Dates Awaiting NTP

Project	Description	Owner	Engineer	Amount w/CO's
19-808	South County WRF Set No 3-4 Rehab & Filter Influent Channel Mods			
	Demo of all filter equipment, media and electrical devices. Install two (2) new complete filter systems and replacement works. Filter tank cleaning, bridges, pumps, media, slide gates, electrical feed system, control, panel and spacer bars. New slide gates for influent, bypass, overflow chambers, filters. Grating, handrails, new PWS water and potable lines improvements with pipe supports	Collier County 3295 Tamiami Trail East, Bldg C-2 Naples, FL 34112 (239) 252-8944	Hole Montes 950 Encore Way Naples, FL 34110 (239) 254-2000	\$ 1,893,990.00 \$ - \$ 1,893,990.00
	VFDs level sensors, piping, valves, power system, level sensor, SCADA.			Completion Dates Awaiting NTP

INTERCOUNTY ENGINEERING, INC. COMPLETED PROJECTS					
Project	Description	Owner	Engineer	Amount w/CO's	
16-700	WWTP Influent Pump Station Furnish and install new pump station structure, including electrical building and stand-by generator facility, New pumps, piping, electrical instrumentation, panels, VFD's, valves, generator with fuel storage tank, fuel, Construction of structures, slabs, site preparation and restoration, cleaning and testing.	City of Homestead 551 SE 8 Street Homestead, FL 33030 Julio Brea (305) 224-4786 jbrea@cityofhomestead.com	Hazen and Sawyer 999 Ponce De Leon Blvd #1150 Coral Gables, FL 33134 Michael Vinas (305) 443-4001 mvinas@hazenandsawyer.com	\$ 6,100,900.00 \$ (1,234,456.69) \$ 4,866,443.31	
	Two cofferdams - 240 feet/40' depths sheet piling 11,000 SF coating application at Main Influent Pump Station.				Completion Dates 01/17 - 03/19
18-100	Lift Station No 54 Wet Well Lining Removal of existing pipes, replacement of discharge pipes and 8000SF of internal coating application of Sewercoat. Restoration of all affected areas.	Seacoast Utility Authority 4200 Hood Road Palm Beach Gardens, FL 33410 Brent Weidenhamer (561) 627-2900 bweidenhamer@sua.com	Chen Moore & Associates 500 Australian Avenue #850 West Palm Beach, FL 33401 Suzanne Dombrowski, P.E. (561) 746-6900 SDombrowski@chenmoore.com	\$ 293,790.00 \$ - \$ 293,790.00	Completion Dates 04/18 - 01/19
17-300	Sanitary Sewer Pump Station B-10 Rehab Complete rehabilitation of wet-pit/dry-pit including demo and disposal of mechanical, electrical, ventilation equipment including pipes, pumps, valves, electrical wiring, lighting and replacement of all new equipment and materials, hatches, miscellaneous metalwork, concrete repairs, cleaning and painting. Site work including asphalt milling, resurfacing and landscaping.	City of Fort Lauderdale 100 N. Andrews Avenue Fort Lauderdale, FL 33301 Jorge Holguin, Senior Project Manager (954) 828-5675 jholguin@fortlauderdale.gov	Calvin, Giordano & Associates, Inc. 1800 Eller Drive Suite 600 Fort Lauderdale, FL 33316 Nico Kanelidis, P.E. (954) 921-7781 Nkanelidis@cgsolutions.com	\$ 1,471,139.00 \$ (149,877.20) \$ 1,321,261.80	Completion Dates 11/17 - 02/19
17-200	Central Beach Alliance Pump Station D-41 Construct and redirect gravity sewer network to new station, demolish, grout and abandon existing pump station and all associated sewer piping, mill, resurface project area and all restoration. Includes (Water Main - 4", 6" & 12") Cofferdam - 25'x25'	City of Fort Lauderdale 100 N. Andrews Avenue Fort Lauderdale, FL 33301 Herbert Stanley, Project Manager (954) 828-6801 hstanley@fortlauderdale.gov	Calvin, Giordano & Associates, Inc. 1800 Eller Drive Suite 600 Fort Lauderdale, FL 33316 Nico Kanelidis, P.E. (954) 921-7781 Nkanelidis@cgsolutions.com	\$ 1,684,626.25 \$ (57,593.26) \$ 1,627,032.99	Completion Dates 7/17 - 10/18
17-100	Upgrades for Lift Stations No 33 & 226 Demo of existing sanitary lift station; installation of new sanitary lift station; rehab of existing station installation of force mains by both open-cut and directional drill methods. Installation of associated electrical systems and power feed.	City of Boca Raton 1401 Glades Road Boca Raton, FL 33431 Lauren M. Burack, P.E. (561) 338-7329	Mathews Consulting 477 S. Rosemary Ave., Suite 330 West Palm Beach, FL 33401 Aaron Cutler, Vice President (561) 655-6175, Ext. 7714	\$ 1,640,639.00 \$ 23,953.11 \$ 1,664,592.11	Completion Dates 2/17 - 05/18

Project 16-800			Owner City of Fort Lauderdale 100 N. Andrews Avenue Fort Lauderdale, FL 33301	Engineer City of Fort Lauderdale 100 N. Andrews Avenue Fort Lauderdale, FL 33301	Amount w/CO's \$ 1,283,550.00 \$ (252,576.84) \$ 1,030,973.16
	Sanitary Sewer Pump Station A-12 Rehabilitation				
	Rehabilitation of a wet-pit/dry-pit pump station including demolition and replacement of mechanical and electrical equipment, piping, pumps, valves, concrete repairs, cleaning, painting and restoration.				
		Herbert Stanley, Project Manager (954) 828-6801	Stan Edwards, Project Engineer (954) 828-5071		Completion Dates 01/17 - 03/18
		hstanley@fortlauderdale.gov	sedwards@fortlauderdale.gov		
Project 15-400			Owner City of Miramar 13900 Pembroke Road Miramar, FL 33027 Stephen Glatthorn (954) 883-5845 sglatthorn@miramarfl.gov	Engineer City of Miramar 13900 Pembroke Road Miramar, FL 33027 Stephen Glatthorn (954) 883-5845 sglatthorn@miramarfl.gov	Amount w/CO's \$ 531,048.00 \$ (2,023.42) \$ 529,024.58 Completion Dates 05/16 - 04/18
	WWRF Injection Pump Station				
	Remove and install a new pump, new VFD's and new check valves at the Wastewater Reclamation Facility				
Project 16-100			Owner City of Boca Utilities 1401 Glades Road Boca Raton, FL 33431 Todd Kiernan (561) 338-7315 tkiernan@myboca.us	Engineer City of Boca Utilities 1401 Glades Road Boca Raton, FL 33431 Todd Kiernan (561) 338-7315 tkiernan@myboca.us	Amount w/CO's \$ 219,733.00 \$ - \$ 219,733.00 Completion Dates 05/16 - 06/16
	Emergency Rehab for Lift Stations 197 & 213				
	Retrofit/rehabilitate each station with new pumps, piping, instrumentation and controls, electrical, manhole coatings and by-pass pumping.				
Project 15-200			Owner City of Cooper City 11791 SW 49 Street Cooper City, FL 33330 James Molaschi (954) 434-5519 jmolaschi@coopercityfl.org	Engineer CH2MHILL 550 West Cypress Creek Road Fort Lauderdale, FL Diana-Flore Merisier, P.E. (954) 513-1527 ext 51254	Amount w/CO's \$ 447,710.00 \$ 17,719.57 \$ 465,429.57 Completion Dates 06/15 - 10/15
	Cooper City Lift Station No 07				
	Site work including 40 LF of 10" gravity line to connect to the new wet well, new housekeeping pad, new valve vault. 6" forcemain installed from wet well to force main leaving the existing lift station. Fittings, piping, valves, structures, pumps electrical and SCADA equipment and appurtenances. Site restoration.				
Project 14-210			Owner City of Opa Locka 3400 NW 135 Street, Bldg B Opa Locka, FL 33054 Aina Austin (305) 953-2868 austin@opalockafl.gov	Engineer City of Opa Locka 3400 NW 135 Street, Bldg B Opa Locka, FL 33054 Magsood Mohammad Nasir, P.E. (305) 953-2868	Amount w/CO's \$ 384,000.00 \$ 3,305.36 \$ 387,305.36 Completion Dates 07/14 - 12/14
	Pump Station 118 Rehab & Upgrades				
	Installation of 6" DI discharge pipe from wet well thru valve vault and tie-in to existing force main. New wet well connected to existing well with 12" PVC C900 gravity pipe and existing wet well changed to manhole. Two pumps installed, control panel and electrical rack.				

Project	Description	Owner	Engineer	Amount w/CO's
12-670	Pump Station 127 Upgrades			
	Demo existing station, install bypass system and tie-in.	City of Hialeah	Hazen and Sawyer	\$ 298,430.00
	New valve vault, clean and coat existing wet well, piping, valves, electrical system components.	501 Palm Avenue Hialeah, FL 33010 Cesar Castillo, P.E. (305) 883-5800	4000 Hollywood Boulevard Hollywood, FL 33021 Ana Garcia, P.E. (954) 987-0066 agarcia@hazenandsawyer.com	\$ (28,590.95) \$ 269,839.05 Completion Dates 05/14 - 10/14
13-710	Rehabilitation of Lift Stations 09, 28, 29 & 53			
	Converting dry can lift stations into duplex submersible lift stations. Remove and replace top slab of wet well and coat interior with Sewpercoat. Install valve vault	City of Deerfield Beach	City of Deerfield Beach	\$ 393,565.00
	Install 6" DIP, valves & fittings through valve vault to tie in into existing force main.	401 SW 4 Street Deerfield Beach, FL 33441 Fred Scott (954) 410-4336 fscott@deerfield-beach.com	401 SW 4 Street Deerfield Beach, FL 33441 Fred Scott (954) 410-4336 fscott@deerfield-beach.com	\$ - \$ 393,565.00 Completion Dates 11/13 - 07/14
12-665	Rehabilitation of Lift Stations 11B, 11C, 12D, 12E, 13A, 13B, 13C, 13D & Four (4) Grinder Stations			
	Demo, architectural, structural, mechanical, electrical instrumentation, civil and site improvements	City of Coral Springs	Eckler Engineering, Inc.	\$ 1,678,000.00
		9551 West Sample Road Coral Springs, FL 33065 Leo Bermudez (954) 344-1101 lbermudez@coralsprings.org	4700 Riverside Drive Coral Springs, FL 33067 Omar Khan (954) 510-4700 pkhan@ecklerengineering.com	\$ (17,619.46) \$ 1,660,380.54 Completion Dates 03/13 - 07/14
12-650	Lift Station 100A Upgrade			
	Rehabilitation of existing lift station 100A installing a tremie wet well structure and pump. New valve vault and forcemain piping into the existing wet well and a new generator.	City of Delray Beach	Mathews Consulting	\$ 406,700.00
		434 S. Swinton Avenue Delray Beach, FL Victor Majtenyi (561) 243-7328 majtenyi@mydelraybeach.com	477 S. Rosemary Ave., Suite 330 West Palm Beach, FL 33401 Dave Mathews (561) 655-6175 dmathews@baxterwoodman.com	\$ (21,082.79) \$ 385,617.21 Completion Dates 09/12 - 05/13
12-675	Rehabilitation of Lift Stations 26, 37 & 40			
	Converting dry can lift stations into duplex submersible lift stations. Remove and replace top slab of wet well and coat interior with Sewpercoat. Install valve vault	City of Deerfield Beach	City of Deerfield Beach	\$ 359,456.00
	Install 6" DIP, valves & fittings through valve vault to tie in into existing force main.	401 SW 4 Street Deerfield Beach, FL 33441 Fred Scott (954) 410-4336 fscott@deerfield-beach.com	401 SW 4 Street Deerfield Beach, FL 33441 Fred Scott (954) 410-4336 fscott@deerfield-beach.com	\$ - \$ 359,456.00 Completion Dates 02/12 - 04/13
11-535	Lift Station Conversion/Upgrade A-3, A-8, W-6 & W-26			
	Conversion and upgrade of four (4) existing lift stations requiring bypass pumping, removal of various structures pipe, pumps and electrical panels. Installation of new submersible pumps, electrical panels, piping and site work.	City of Hollywood	AECOM USA Inc.	\$ 1,291,640.00
		1621 N. 14th Ave Hollywood, Florida 33022 James Mortel (954) 967-4455	13450 W Sunrise Boulevard #200 Sunrise, FL 33323 James G. Penkosky, PE (954) 851-1404	\$ (254,295.52) \$ 1,037,344.48 Completion Dates 12/11 - 03/13

<i>Project</i>	<i>Description</i>	<i>Owner</i>	<i>Engineer</i>	<i>Amount w/CO's</i>	
10-390	Pompano Beach Lift Station 21 Replacement Construction of lift station located within single story 3800 sf building. Project includes auger pilings, cast-in-place below ground valve vault and pipe trench, sanitary sewer main replacement on FDOT roadway, new force main, water main, landscaping, structural, roofing, plumbing electrical and instrumentation.	City of Pompano Beach 1201 NE 3 Avenue Pompano Beach, FL Tammy Good (954) 786-5512 tammygood1@copbfl.com	Chen & Associates 500 West Cypress Creek Road Fort Lauderdale, FL 33309 Peter Chen P.E. (954) 730-0707	\$ 3,749,000.00 \$ - \$ 3,749,000.00 Completion Dates 06/10 -12/11	
09-310	Midway Pump Station Installation of storm sewer structures and pipe. Install double 36" HDPE casing pipe via directional drill under SR-826. Construct below ground CIP pump station.	Miami Dade County Public Works 111 NW 1 Street, Suite 1510 Miami, FL 33128 Daryl Hildoer (305) 375-4972	Engineer Corzo Castella Carballo Thompson Salman Engineers 901 Ponce de Leon Blvd #900 Coral Gables, FL 33134 (305) 445-2900	\$ 4,258,613.60 \$ - \$ 4,258,613.60 Completion Dates 08/09 - 02/11	

SECTION 00500

CONTRACT

THIS AGREEMENT, made and entered into, this ____ day of _____, A.D., _____, by and between the CITY OF HOLLYWOOD, Florida, a municipal corporation of the State of Florida, part of the first part, (hereinafter sometimes called the "CITY"), and

Intercounty Engineering, Inc.

party of the second part (hereinafter sometimes called the "CONTRACTOR").

WITNESSETH: The parties hereto, for the considerations herein- after set forth, mutually agree as follows:

Article 1. Scope of Work: The CONTRACTOR shall furnish all labor, materials, and equipment and perform all work in the manner and form provided by the Contract Documents, for:

RAS Pump Station No. 1 Replacement Project No. 17-9523

Article 2. The Contract Sum: The CITY shall pay to the CONTRACTOR, for the faithful performance of the Contract, in lawful money of the United States of America, and subject to additions and deductions as provided in the Contract Documents, as follows:

Based upon the prices shown in the Proposal heretofore submitted to the CITY by the CONTRACTOR, a copy of said Proposal being a part of these Contract Documents, the aggregate amount of this Contract being the sum of **Three Million Nine Hundred Ninety-One Thousand Eight Hundred Twenty-Eight and 00/dollars (\$3,991,828.00).**

Article 3. Partial and Final Payments: In accordance with the provisions fully set forth in the "General Conditions" of the "Specifications", and subject to additions and deductions as provided, the CITY shall pay the CONTRACTOR as follows:

- (a) On the 15th day, or the first business day thereafter, of each calendar month, the CITY shall make partial payments to the CONTRACTOR on the basis of a duly certified and approved estimate of work performed during the preceding calendar month by the CONTRACTOR, less ten percent (10%) of the amount of such estimate which is to be retained by the CITY until all work has been performed strictly in accordance with this Agreement and until such work has been accepted by the CITY; provided, however, that after 50 percent (50%) completion of the work covered by this Agreement, (i) the amount retained from each subsequent progress payment shall be reduced to 5 percent (5%) and (ii) upon presentation by the CONTRACTOR of a payment request for up to one-half of the retainage held by the CITY, the CITY shall promptly make payment to the CONTRACTOR. The parties' rights and obligations regarding retainage are further specified in Florida Statute Section 218.735.

- (b) Upon submission by the CONTRACTOR of evidence satisfactory to the CITY that all payrolls, material bills and other costs incurred by the CONTRACTOR in connection with the construction of the WORK have been paid in full, and also, after all guarantees that may be required in the Specifications have been furnished and are found acceptable by the CITY, final payment on account of this Agreement shall be made within sixty (60) days after completion by the CONTRACTOR of all work covered by this Agreement and acceptance of such work by the ENGINEER and approved by the CITY.

Article 4. Time of Completion: The CONTRACTOR shall commence work to be performed under this Contract within ten (10) consecutive calendar days after date of written Notice To Proceed and shall fully complete the Contract in accordance within the Contract Documents and meet all intermediate milestone completion dates required after said date of written notice as set forth in the Proposal, as may be modified by Instructions to Bidders, and stated in the Notice to Proceed.

It is mutually agreed between the parties hereto, that time is the essence, and in the event that construction of the WORK is not completed within the Contract Time and per intermediate dates, as may have been modified solely in accordance with the General Conditions of this Contract, that from the compensation otherwise to be paid to the CONTRACTOR, the CITY is authorized and shall retain, for each day thereafter, Sundays and holidays included, the sum set forth in the Supplementary General Conditions of this Contract as liquidated damages sustained by the CITY in the event of such default by the CONTRACTOR, or shall withhold such compensation for actual and consequential damages as may be stated therein or contemplated therefrom.

Article 5. Additional Bond: It is further mutually agreed between the parties hereto, that if, at any time after the execution of this Agreement and the Payment and Performance Bonds required herein for the express purpose of assuring the faithful performance of the Contractor's work hereto attached, the CITY shall deem the surety or sureties' to be unsatisfactory, or, if for any reason, said bonds cease to be adequate to cover the performance of the work, the CONTRACTOR shall, at his expense, within five (5) days after receipt of notice from the CITY furnish an additional bond or bonds in such form and amount, and with such surety or sureties as shall be satisfactory to the CITY. In such event, no further payment to the CONTRACTOR shall be deemed to be due under this agreement until such new or additional security for the faithful performance of the work shall be furnished in manner and form satisfactory to the CITY.

Article 6. Contract Documents: All of the documents hereinafter listed form the Contract and they are as fully a part of the Contract as if hereto attached, or repeated in this Agreement:

- | | |
|--------------------------------------|--------------------------------------|
| 1. Notice to Bidders | 9. Contract |
| 2. Instruction to Bidders | 10. Performance Bond |
| 3. Proposal | 11. Payment Bond |
| 4. Proposal Bid Form | 12. General Conditions |
| 5. Bid Bond | 13. Supplementary General Conditions |
| 6. Information Required from Bidders | 14. Addenda |
| 7. Local Preference (Exhibit "A") | 15. Specifications |
| 8. Trench Safety Form | 16. Drawings |

Article 7. The rate of wages and fringe benefits, or cash equivalent, for all laborers, mechanics and apprentices employed by any contractor or subcontractor on the work covered by the contract shall be not less than the prevailing rate of wages and fringe benefit payments or cash equivalent for similar skills or classifications of work as established by the General Wage Decision by the United States Department of Labor for Broward County, Florida that is in effect prior to the date the city issues its invitation for bids. If the General Wage Decision fails to provide for a fringe benefit rate for any worker classification, then the fringe benefit rate applicable to the worker classification shall be the fringe benefit rate applicable to the worker classification with a fringe benefit rate that has a basic hourly wage closest in dollar amount to the worker classification for which no fringe benefit rate has been provided.

Article 8. No additional work or extras shall be performed unless the same be duly authorized by appropriate action of the City.

Article 9. That in the event either party brings suit for enforcement of disagreement, the prevailing party shall be entitled to attorney's fees and court costs in addition to any other remedy afforded by law.

Article 10. The Contractor shall guarantee the complete project against poor workmanship and faulty materials for a period of twelve (12) months after final payment and shall immediately correct any defects which may appear during this period upon notification by the City or the Engineer.

Article 11. The making and acceptance of the final payment shall constitute a waiver of all claims by the Contractor, except those previously made and still unsettled.

IN WITNESS WHEREOF the parties hereto have executed this Agreement on the day and date first above written in three (3) counterparts, each of which shall, without proof or accounting for the other counterparts, be deemed an original contract:

THE CITY OF HOLLYWOOD, FLORIDA
Party of the First Part

By: _____ (SEAL)
JOSH LEVY, MAYOR

ATTEST:

PATRICIA A. CERNY, MMC
City Clerk

CONTRACTOR
Party of the Second Part

WHEN THE CONTRACTOR IS AN INDIVIDUAL:

Signed, sealed and delivered in the presence of:

_____	_____ (SEAL)
(Witness)	(Signature of Individual)

_____	_____
(Witness)	(Signature of Individual)

WHEN THE CONTRACTOR IS A SOLE PROPRIETORSHIP OR OPERATES UNDER A TRADE NAME:

Signed, sealed and delivered in the presence of:

_____	_____
(Witness)	(Name of Firm)
_____	_____ (SEAL)
(Witness)	(Signature of Individual)

WHEN THE CONTRACTOR IS A PARTNERSHIP:

_____	_____
(Witness)	(Name of Firm) a Partnership
_____	BY: _____ (SEAL)
(Witness)	(Partner)

WHEN THE CONTRACTOR IS A CORPORATION:

Attest:

Secretary

(Correct Name of Corporation)

BY: _____ (SEAL)
President

APPROVED AS TO FORM
AND LEGAL SUFFICIENCY
for the use and reliance of the
City of Hollywood, Florida only:

APPROVED AS TO FINANCE:

By _____
DOUGLAS R. GONZALES
City Attorney

By _____
CINTYA RAMOS
Financial Services Department Director

CERTIFICATE

**STATE OF FLORIDA)
COUNTY OF BROWARD)**

I HEREBY CERTIFY that a meeting of the Board of Directors of _____,
a corporation under the laws of the State of _____, was held on _____,
20____, and the following resolution was duly passed and adopted:

"RESOLVED, that _____ as _____ President of the corporation,
be and he is hereby authorized to execute the contracts on behalf of this
corporation, and that his execution thereof, attested by the Secretary of
the corporation and with corporate seal affixed, shall be the official act and
deed of this corporation."

I further certify that said resolution is now in full force and effect.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed the official seal of
the corporation, this _____ day of _____, 20____.

Secretary

- END OF SECTION -

SECTION 00610

PERFORMANCE BOND

KNOW ALL MEN BY THESE PRESENTS:

That we _____,

as Principal, and _____,

as Surety, are held and firmly bound unto the City of Hollywood in the sum of _____ Dollars (\$_____),

for the payment of said sum we bind ourselves, our heirs, executors, administrators and assigns, jointly and severally, for the faithful performance of a certain written contract, dated the _____ day of _____, 20____ entered into between the Principal and the City of Hollywood, Florida, for the installation of **RAS PUMP STATION NO.1 REPLACEMENT, Project No. 17-9523.**

A copy of said Contract, No. 17-9523, is incorporated herein by reference and is made a part hereof as if fully copied herein.

NOW, THEREFORE, THE CONDITIONS OF THIS OBLIGATION ARE SUCH, that if the Principal shall in all respects comply with the terms and conditions of said Contract and his obligations thereunder, including all of the Contract Documents (that include the Notice to Bidders, Instructions to Bidders, Proposal, Proposal Bid Form, Basis of Payment, Approved Bid Bond, Trench Safety Form, Information Required from Bidders, Contract, Performance Bond, Payment Bond, General and Supplementary General Conditions, Technical Specifications, Addenda and Drawings), therein referred to and made a part thereof, and such alterations as may be made in said Drawings and Specifications as therein provided for, and shall indemnify and save harmless the City of Hollywood against and from all expenses, damages, injury or conduct, want of care of skill, negligence or default, including patent infringement on the part of said Principal, his agents or employees, in the execution or performance of said Contract, including errors in the Drawings furnished by said Principal, and further, if the Principal shall promptly make payments to all who supply him, with labor and/or materials, used directly or indirectly by the Principal in the prosecution of the work provided for in said Contract, then this obligation shall be null and void; otherwise, the Principal and Surety, jointly and severally, agree to pay the City of Hollywood any difference between the sum that the City of Hollywood may be obliged to pay for the completion of said work, by Contract or otherwise, and the sum that the City of Hollywood would have been obliged to pay for the completion said work had the Principal properly executed all of the provisions of said Contract, and any damages, whether direct, indirect, or consequential, which the City of Hollywood may incur as a result of the failure of the said Principal to properly execute all of the provisions of said Contract.

AND, the said Principal and Surety hereby further bind themselves, their successors, executors, administrators and assigns, jointly and severally, that they will amply and fully protect the City of Hollywood against, and will pay any and all amounts, damages, costs

and judgments which may be recovered against or which the Owner may be called upon to pay to any person or corporation by reason of any damage arising from the performance of the said work, repair or maintenance thereof, or the manner of doing the same, or his agents or his servants, or the infringements of any patent rights by reason of the use of any material furnished or work done, as aforesaid or otherwise.

AND, the said Surety, for value received, hereby stipulates and agrees that no change, extension of time, alteration or addition to the terms of the Contract or to the work to be performed thereunder or the Specifications and Drawings accompanying the same, shall in any way affect its obligations on this Bond, and it does hereby waive notice of any such change, extension of time, alteration or addition to the terms of the Contract or to the work or to the Specifications and Drawings.

WHEN THE PRINCIPAL IS AN INDIVIDUAL:

Signed, sealed and delivered in the presence of:

(Witness)

(Signature of Individual)

(Address)

(Printed Name of Individual)

(Witness)

(Address)

WHEN THE PRINCIPAL IS A SOLE PROPRIETORSHIP OR OPERATES UNDER A TRADE NAME:

Signed, sealed and delivered in the presence of:

(Witness)

(Name of Firm)

(Address)

By: _____
(Seal)
(Signature of Individual)

(Witness)

Address

WHEN THE PRINCIPAL IS A PARTNERSHIP:

Signed, sealed and delivered in the presence of:

(Witness)

(Name of Partnership)

(Address)

By: _____
(Seal)
(Partner)

(Witness)

(Printed Name of Partner)

Address

WHEN THE PRINCIPAL IS A CORPORATION:

Attest:

(Secretary)

(Name of Corporation)

By: _____
(Seal)
(Affix Corporate Seal)

(Printed Name)

(Official Title)

CERTIFICATE AS TO CORPORATE PRINCIPAL

I, _____, certify that I am the Secretary of the corporation named as Principal in the within bond; that _____, who signed the said bond on behalf of the Principal was then _____ of said corporation; that I know his signature, and his signature thereto is genuine; and that said Bond was duly signed, sealed and attested for and on behalf of said corporation by authority of its governing body.

Secretary (SEAL)

TO BE EXECUTED BY CORPORATE SURETY

Attest:

(Secretary)

(Corporate Surety)

(Business Address)

By: _____
(Affix Corporate Seal)

(Attorney-In-Fact)

(Name of Local Agency)

(Business Address)

STATE OF FLORIDA

Before me, a Notary Public, duly commissioned, qualified and acting, personally appeared, _____ to me well known, who being by me first duly sworn upon oath, says that he is the attorney-in-fact for the _____ and that he has been authorized by _____ to execute the foregoing bond on behalf of the CONTRACTOR named therein in favor of the City of Hollywood, Florida.

Subscribed and sworn to before me this _____ day of _____, 20____.

Notary Public, State of Florida
My Commission Expires:

APPROVED AS TO FORM AND
LEGAL SUFFICIENCY
for the use and reliance of the
City of Hollywood, Florida only:

APPROVED AS TO FINANCE:

By _____
Douglas R. Gonzales, City Attorney

By _____
Cintya Ramos
Financial Services Department Director

- END OF SECTION -

SECTION 00620

PAYMENT BOND

KNOW ALL MEN BY THESE PRESENTS:

That we, _____
Name Address Tel. No.

As Principal and _____
Name Address Tel. No.

as Surety, are held and firmly bound to the CITY OF HOLLYWOOD, FLORIDA herein called the City, in the sum of _____

_____ Dollars (\$ _____) for the payment of said sum we bind ourselves, our heirs, executors, administrators and assigns, jointly and severally, for the faithful performance of a certain written contract dated the _____ day of _____, 20____, entered into between the Principal and the City of Hollywood, Florida for the **RAS PUMP STATION NO. 1 REPLACEMENT, Project No. 17-9523**

Which contract is by reference made a part hereof, and is hereinafter referred to as the Contract.

THE CONDITION of this bond is that if Principal promptly makes payments to all claimants defined in Section 255.05 (1), F.S., supplying Principal with labor, materials or supplies used directly or indirectly by principal in the prosecution of the work provided for in the Contract, then this bond shall be null and void and of no further force and effect; otherwise to remain in full force and effect.

Said surety for value received hereby stipulates and agrees that no change, extension of time, alteration or addition to the terms of the contract or any other changes in or under contract documents and compliance or noncompliance with any formalities connected with the contract does not affect Surety's obligation under this bond and Surety waives notice of any such change, extension of time, alteration or addition to the terms of the Contract or any other changes, compliance, or noncompliance to the terms of the Contract or to the Work or to the Specifications.

This bond is furnished pursuant to the statutory requirements for bond on public works projects being Florida Statute 255.05. Claimants are hereby notified that the Statute 255.05(2) specifically requires that notice be given to Contractor within 45 days after beginning to furnish labor, materials or supplies for the prosecution of the work that claimants intends to look to the bond for protection. Further notice is hereby given claimants that written notice of nonpayment within ninety (90) days after performance of the labor or after complete delivery of the materials or supplies must be delivered to the Contractor and to the Surety. Further notice is hereby given that no action for labor, materials or supplies may be instituted against the Contractor or the Surety on the bond after one year for the performance of the labor or completion of delivery of the materials or supplies.

Without modifying the foregoing, this bond shall be construed as requiring of the principal and surety no more and no less than is specified in F.S. 255.050.

SIGNED AND SEALED, this _____ day of _____, 20____.

PRINCIPAL:

ATTEST:

_____	_____
	(Signature)
_____	_____
	(Title)

(SEAL)

SURETY:

	(Surety)
ATTEST:	
_____	_____
	(Signature)
_____	_____
	(Attorney-in-Fact)

APPROVED AS TO FORM AND
LEGAL SUFFICIENCY
for the use and reliance of the
City of Hollywood, Florida only:

By _____
Douglas R. Gonzales City Attorney

APPROVED AS TO FINANCE:

By _____
Cintya Ramos
Financial Services Department Director

- END OF SECTION -

SECTION 00700

**GENERAL CONDITIONS
OF THE CONSTRUCTION CONTRACT**

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GENERAL CONDITIONS

ARTICLE 1 – DEFINITIONS, TERMINOLOGY AND ORGANIZATIONAL ABBREVIATIONS

1.01 Defined Terms

- A. Wherever used in the Bidding Requirements or Contract Documents and printed with initial capital letters, the terms listed below will have the meanings indicated which are applicable to both the singular and plural thereof. In addition to terms specifically defined, terms with initial capital letters in the Contract Documents include references to identified articles and paragraphs, and the titles of other documents or forms.

ADDENDA - Written or graphic instruments issued prior to the opening of Bids which clarify, correct or change the Contract Documents.

CHANGE ORDER - A written order to CONTRACTOR executed in accordance with City procurement procedures, as amended authorizing an addition, deletion or revision in the work, or an adjustment in the Contract Price or the Contract Time, issued after the date of Award.

CITY (CITY) - The City of Hollywood, Florida.

COMMERCIALLY USEFUL FUNCTION - shall exist when the Local Preference is responsible for execution of the work for the contract and is carrying out the responsibilities by actually performing, managing and supervising the work involved. The Local Preference must also be responsible, with respect to materials and supplies used on the contract, for negotiating price, determining quality and quantity, and ordering the material, and installing. A commercially useful function is not performed if the role of the qualified Local Preference is that of an extra participant in a transaction, contract, or project through which funds are passed in order to obtain the appearance of qualified Local Preference participation.

COMMISSION - The City Commission of the City of Hollywood, Florida, being the legislative body of the CITY as set forth in the City of Hollywood Charter.

CONTRACT - The written agreement between the CITY and the CONTRACTOR covering the work to be performed in accordance with the other Contract Documents which are attached to the Contract and made a part thereof.

CONTRACTOR - The person, firm, or corporation with whom the CITY has entered into the Contract.

CONTRACT DOCUMENTS - The Notice to Bidders, Instruction to Bidders, Proposal, Information Required of Bidders, all Bonds, Agreement, and all supporting documents, these General Requirements and Covenants, the Specifications, Drawings and Permits, together with all Addenda and Change Orders issued with respect thereto.

CONTRACT PRICE - Total monies payable by the CITY to the CONTRACTOR under the terms and conditions of the Contract Documents.

CONTRACT TIME - The number of days agreed to in the Proposal, commencing with the date of the Notice to Proceed for completion of the work.

CONTROL - shall mean having the primary power, direct or indirect, to influence the management of a business enterprise. The controlling party must have the demonstrable ability to make independent and unilateral business decisions on a day-to-day basis, as well as the independent and unilateral ability to make decisions which may influence and chart the future course of the business.

DATE OF SUBSTANTIAL COMPLETION - The date when the work on the project, or specified part thereof, is substantially completed in accordance with the Contract Documents, such that the CITY can occupy or utilize the project or specified part thereof for the use and purpose for which it was intended as determined and accepted by the Engineer.

DAYS - Calendar days of 24 hours measured from midnight.

DRAWINGS - The drawings which show the character and scope of the work to be performed and which have been prepared by the DESIGN ENGINEER approved by ENGINEER and are referred to in and are a part of the Contract Documents.

ENGINEER - The Director of Public Utilities of the CITY of Hollywood, Florida, or his authorized designee.

EXCUSABLE DELAY - Delay caused by the CITY, hurricane, tornadoes, fires, floods, epidemics or labor strikes.

GENERAL CONDITIONS - That segment of the Contract Specifications incorporating the Provisions common to all CITY Construction Contracts.

INEXCUSABLE DELAY - Any delay caused either (i) by events or circumstances within the control of the CONTRACTOR not specified in the definition of excusable delay.

INSPECTOR - The authorized field representative of the ENGINEER.

LIQUIDATED DAMAGES - The amount prescribed in the General Requirements to be paid the CITY, or to be deducted from any payments due the CONTRACTOR for each day's delay in completing the whole or any specified portion of the work beyond the Contract Time.

LOCAL BUSINESS – shall mean a business which is duly licensed and authorized to engage in the business at issue and which maintains a permanent principal place of operation with full time personnel within the corporate limits of the City of Hollywood, Florida. A Post Office Box (P.O. Box) shall not be sufficient to constitute a “local business.” The business has the burden of demonstrating that it meets this definition.

MINORITY – shall mean a person who is a citizen or lawful permanent resident of the United States and who is a Woman, Black American, Hispanic American, Native American, Asian Pacific American, Subcontinent Asian American or other minorities found to be disadvantaged by the SBA.

NOTICE OF AWARD - The written notice by the CITY to the successful Bidder stating that upon his execution of the Agreement and other requirements as listed therein within the time specified the CITY will sign and deliver the Agreement.

MINORITY BUSINESS ENTERPRISE – shall mean a currently functioning business enterprise which (a) is an independent for profit business concern that is at least 51% owned by minority group member(s); (b) is independently operated and controlled by the minority group member(s); (c) demonstrates the capability to perform a line of business; (d) provides a commercially useful function according to the customs and practices of the industry and (e) is qualified by the City of Hollywood, Florida.

NOTICE TO PROCEED - A written notice by the ENGINEER to the CONTRACTOR fixing the date on which the Contract Time will commence to run and on which the CONTRACTOR shall start to perform his obligation under the Contract Documents.

"OR EQUAL" - Equivalent or superior in construction, efficiency and effectiveness to a type, brand, model or process called out in the Contract Documents to establish a basis of quality as determined by the ENGINEER.

SHOP DRAWINGS - All certified affidavits, drawings, diagrams, illustrations, schedules and other data which are specifically prepared by CONTRACTOR, a Subcontractor, manufacturer, fabricator, supplier or distributor to illustrate some portion of the work and all illustrations, brochures, standard schedules, performance charts, instructions, diagrams and other information prepared by a manufacturer, fabricator, supplier or distributor and submitted by CONTRACTOR to illustrate material or equipment for some portion of the WORK.

SPECIFICATIONS - Division 1 through 17 of these Contract Documents, consisting of administrative details and written technical descriptions of materials, equipment, standards and workmanship.

SUPPLEMENTARY CONDITIONS - Division 1 of the Contract Specifications incorporating the provisions peculiar to a specific project.

SUBCONTRACTOR - An individual, firm or corporation having a direct contract with CONTRACTOR or with any other Subcontractor for the performance of a part of the work

SURETY - The person, firm or corporation responsible for the Bidder's acts in the execution of the Contract, or which is bound to the CITY with and for the CONTRACTOR to insure performance of the Contract and payment of all obligations pertaining to the work.

WORK - All the work materials or products specified, indicated, shown or contemplated in the Contract Documents to construct and complete the improvement, including all alterations, modifications, amendments or extension thereto made by Change Orders.

1.02 Terminology

A. The words and terms referenced in this Paragraph 1.02 are not defined but, when used in the Bidding Requirements or Contract Documents, have the indicated meaning.

B. *Intent of Certain Terms or Adjectives*

1. The Contract Documents include the terms “as allowed”, “as approved”, “as ordered”, “as directed” or terms of like effect or import to authorize an exercise of professional judgment by Engineer. In addition, the adjectives “reasonable,” “suitable,” “acceptable,” “proper,” “satisfactory,” or adjectives of like effect or import are used to describe an action or determination of Engineer as to the Work. It is intended that such exercise of professional judgment, action or determination will be solely to evaluate, in general, the Work for compliance with information in the Contract Documents and with the design concept of the Project as a functioning whole as shown or indicated in the Contract Documents (unless there is a specific statement indicating otherwise). The use of any such term or adjective is not intended to and shall not be effective to assign to Engineer any duty or authority to supervise or direct the performance of the Work or any duty or authority to undertake responsibility contrary to the provisions of Paragraph 9.09 or any other provision of the Contract Documents.

C. *Day*

1. The word “day” means a calendar day of 24 hours measured from midnight to the next midnight.

D. *Defective*

1. The word “defective,” when modifying the word “Work,” refers to Work that is unsatisfactory, faulty, or deficient in that it:
 - a. does not conform to the Contract Documents, or
 - b. does not meet the requirements of any applicable inspection, reference standard, test, or approval referred to in the Contract Documents, or
 - c. has been damaged prior to Engineer’s recommendation of final payment (unless responsibility for the protection thereof has been assumed by City at Substantial Completion in accordance with Paragraph 14.04 or 14.05).

E. *Furnish, Install, Perform, Provide*

1. The word “furnish,” when used in connection with services, materials, or equipment, shall mean to supply and deliver said services, materials, or equipment to the Site (or some other specified location) ready for use or installation and in usable or operable condition.
2. The word “install,” when used in connection with services, materials, or equipment, shall mean to put into use or place in final position said services, materials, or equipment complete and ready for intended use.
3. The words “perform” or “provide,” when used in connection with services, materials, or equipment, shall mean to furnish and install said services, materials, or equipment complete and ready for intended use.
4. When “furnish,” “install,” “perform,” or “provide” is not used in connection with services, materials, or equipment in a context clearly requiring an obligation of Contractor, “provide” is implied.

- F. Unless stated otherwise in the Contract Documents, words or phrases that have a well-known technical or construction industry or trade meaning are used in the Contract Documents in accordance with such recognized meaning.

1.03 Organizational Abbreviations

Abbreviations of organizations which may be used in these Specifications are:

AASHTO: American Association of State Highway and Transportation Officials

ACI: American Concrete Institute

AIA: American Institute of Architects

AISC: American Institute of Steel Construction

AITC: American Institute of Timber Construction

ANSI: American National Standards Institute

APWA: American Public Works Association

ASTM: American Society for Testing and Materials

ASCE: American Society of Civil Engineers

ASME: American Society of Mechanical Engineers

ASHRAE: American Society of Heating, Refrigerating and Air Conditioning Engineers

AWPA: American Wood Preservers Association
AWWA: American Water Works Association
AWS: American Welding Society
BCEQCB: Broward County Environmental Quality Control Board
CRSI: Concrete Reinforcing Steel Institute
FDEP: Florida Department of Environmental Protection
FDNR: Florida Department of Natural Resources
FDOT: Florida Department of Transportation
FPL: Florida Power and Light
IEEE: Institute of Electrical and Electronic Engineers
NACE: National Association of Corrosion Engineers
NCPI: National Clay Pipe Institute
NEC: National Electrical Code
NEMA: National Electrical Manufacturers Association
NFPA: National Fire Protection Association
OSHA: Occupational Safety and Health Act
PCI: Prestressed Concrete Institute
SFBC: South Florida Building Code, Broward Edition, Latest Revision
SFWMD: South Florida Water Management District
SSPC: Structural Steel Painting Council
UL: Underwriters' Laboratories, Inc.
UNCLE: Utility Notification Center for Location before Excavation (1-800-432-4770)
USEPA: United States Environmental Protection Agency
USGS: United States Geological Survey
WWEMA: Water and Wastewater Equipment Manufacturers Association

ARTICLE 2 - PRELIMINARY MATTERS

2.01 Contract Document Discrepancies:

Any discrepancies, conflicts, errors or omissions found in the Contract Documents shall be promptly reported to the ENGINEER who will issue a correction, if necessary, in writing. The CONTRACTOR shall comply with any corrective measures regarding the same as prescribed by the ENGINEER.

2.02 Submissions:

Unless indicated otherwise in the Contract Documents, within seven days subsequent to the CONTRACTOR executing and submitting the required documents of Article 15 in the Instructions to Bidders, the CONTRACTOR shall submit to the ENGINEER an estimated progress schedule indicating the starting and completion days of the various stages of the work. A preliminary Schedule of Values and a preliminary schedule of Shop Drawing submissions may also be required by Section 01300 of Division 1 - General Requirements.

2.03 Pre-construction Conference:

The Contractor will be required to attend a mandatory Pre- Construction Conference for review of the above schedules, establishing procedures and establishing a working understanding among the parties as to the work.

2.04 Contract Time:

The Contract Time will commence on the date of the Notice to Proceed and shall exist for the total number of days as specified in the Proposal Bid Form as modified by any subsequent Change Orders, Unless the CONTRACTOR fails to complete the requirements of the Instructions to Bidders, the additional time in days (including weekends) required to correctly complete the documents will be deducted by CITY from the Contract Time specified by the CONTRACTOR in this Proposal.

2.05 Computation of Time:

When any period of time is referred to the Contract Documents by days, it shall be computed to exclude the first and include the last day of such period. If the last day of any such period falls on a Saturday or Sunday or on a legal holiday, such day shall be omitted from the computation.

2.06 Commencement of Work:

The CONTRACTOR shall not perform work at the site prior to the date of the Notice to Proceed.

2.07 Extension of Contract Time:

Extensions of time shall be based solely upon the effect of delays to the work as a whole. Extensions of time shall not be granted for delays to the work, unless the CONTRACTOR can clearly demonstrate, through schedule analysis, that the delay to the work as a whole arose in accordance with Article 11, Changes in Contract Time and that such delays did or will, in fact, delay the progress of work as a whole. Time extensions shall not be allowed for delays to parts of the work that are not on the critical path of the Project schedule. Time extensions shall not be granted until all float or contingency time, at the time of the delay, available to absorb specific delays and associated impacts, is used.

2.08 Notice and Service Thereof:

All notices, demands, requests, instructions, approvals and claims shall be in writing. Notices, demands, etc. shall be deemed to have been validly given if delivered in person to the individual or to a member of the firm or to an officer of the corporation for whom it is intended, or if delivered at or sent by registered or certified mail, postage prepaid, to the business address as defined at the Pre-Construction Conference.

2.09 Separate Contract:

The CITY reserves the right to let other Contracts in connection with this Project. The CONTRACTOR shall afford other Contractors reasonable opportunity for the introduction and storage for their materials and the execution of their work and shall properly connect and coordinate his work with theirs.

2.10 Assignments of Contract:

No assignment by the CONTRACTOR of the Contract or of any part thereof, or any monies due or to become due thereunder shall be made.

2.11 Patents:

It is mutually understood and agreed that without exception, Contract prices are to include all royalties and costs arising from patents, trademarks, and copyrights in any way involved in the work. It is the intent that whenever the Contractor is required or desired to use any design, device, material or process covered by letters, patent, or copyright, the right for such use shall be provided for by suitable legal agreements with the Patentee or CITY and a copy of this agreement shall be filed with the ENGINEER. However, whether or not such an agreement is made or filed as noted, the CONTRACTOR and the Surety in all cases shall indemnify and save harmless the CITY from any and all claims for infringement by reason of the use of any such patented design, device, material or process, to be performed under the Contract, and shall indemnify the said CITY from any costs, expenses, and damages which it may be obliged to pay, by

reason of such infringement, at any time during the prosecution or after the completion of the work.

2.12 Federal Excise Tax:

The forms needed for applying for exemption certificates for materials and equipment, normally subject to the Federal Excise Tax, may be obtained from the Director of Internal Revenue, Jacksonville, Florida.

The CONTRACTOR is solely responsible for obtaining the desired exemption certificate from the Federal Government.

2.13 Savings Due to Excise Tax Exemptions:

The Bidder shall include in the Bid price the estimated cost of all goods, supplies and equipment which will be incorporated in the Work and the taxes that the Bidder would be required to pay if the Bidder were to purchase such goods, supplies or equipment. By subsequent Change Order(s), the parties shall reduce the Bid price to reflect any goods, supplies and equipment purchased directly by City and the resulting tax savings due to City's exemption from Excise Taxes.

CONTRACTOR shall pay all sales, consumer, use and other similar taxes required to be paid by CONTRACTOR in accordance with the laws and regulations of the State of Florida and its political subdivisions. Consistent with the tax exemption for municipalities provided by state law, CITY and CONTRACTOR shall jointly operate so that CITY may purchase directly, goods, supplies and equipment which will be incorporated into the Work. The goods, supplies and equipment that will be purchased by CITY shall be approved in advance by the parties.

With respect to all goods, supplies and equipment to be purchased by CITY, CONTRACTOR shall, on behalf of CITY, take all actions necessary and appropriate to cause all purchases to be made and shall be responsible for delivery of all such goods, supplies and equipment, including verification of correct quantities and documents or orders, coordination of purchases and delivery schedules, sequence of delivery, unloading, handling and storage through installation, obtaining warranties and guarantees required by the Contract Documents, inspection and acceptance of the goods, supplies and equipment at the time of delivery, and other arrangements normally required for the particular goods, supplies or equipment purchased. Unless otherwise directed by CITY, such actions shall also include taking the lead in efforts to resolve any and all disputes with the vendor. CONTRACTOR shall ensure that each vendor of goods, supplies and equipment purchased by CITY agrees in writing to the terms and conditions contained in CITY'S standard purchase order, which terms and conditions are set forth in Section 00800 of the Contract Documents. Even though CITY may purchase such goods, supplies and equipment, the goods, supplies and equipment shall be stored at the site in the same manner as goods, supplies and equipment purchased by CONTRACTOR.

CONTRACTOR shall hold CITY harmless from delays in manufacturing, delivery, and other unforeseen conditions that may arise as part of the procurement of CITY-purchased goods, supplies and equipment.

2.14 Overtime Work:

The CONTRACTOR shall receive no additional compensation for overtime work, i.e., work in excess of eight hours in any one calendar day or 40 hours in any one calendar week, even though such overtime work may be required under emergency conditions and may be ordered by the ENGINEER in writing. Additional compensation will be paid the CONTRACTOR for overtime work only in the event extra work is ordered by the ENGINEER and the Change Order specifically authorizes the use of overtime work and then only to such extent as overtime wages are regularly being paid by the CONTRACTOR for overtime work of a similar nature in the same locality.

2.15 Inspections and Testing during Overtime:

The CONTRACTOR shall establish a normal work schedule which does not exceed eight hours per day in a normal work day nor forty hours per week in a normal work week. Normal work days shall be Monday through Friday. Whenever CONTRACTOR's work requires scheduled overtime, unless such overtime work is specifically required by the Contract Documents, CONTRACTOR shall reimburse the CITY for the extra costs incurred for providing Inspectors. Overtime shall be scheduled only after CONTRACTOR obtains written permission from the CITY. A change order shall be prepared to cover the CITY costs. Inspector costs shall be charged to the CONTRACTOR at a rate of \$80.00 per hour with a minimum of four hours charged for weekends and holidays. If the CONTRACTOR has an overtime work force size of fifty or more persons a second Inspector will be required and the costs for two Inspectors will be \$160.00 per hour.

2.16 Nights, Sunday or Holiday Work:

Except upon specific permission of the ENGINEER, the CONTRACTOR shall not perform any work on Sundays or on legal State or Municipal holidays. In accordance with City of Hollywood Code of Ordinances, Section 21.49, no work between 6:00 p.m. and 8:00 a.m. will be permitted, except in case of an emergency, that violates Section 21.49 concerning noise levels. All costs of testing and inspection performed during night, Sunday or holiday work shall be borne by the CONTRACTOR. The CONTRACTOR shall notify all regulatory agencies, including but not limited to the City Police Department, Fire Department, and Code Enforcement Department.

2.17 Injury or Damage Claims:

Should CITY or CONTRACTOR suffer injury or damage to their person or property because of any error, omission or act of the other party or of any of the

other party's employees or agents or others for whose acts the other party is legally liable, claim shall be made in writing to the other party within a reasonable time of the first observance of such injury or damage. However, nothing herein shall be deemed to affect the rights, privileges and immunities of City as are set forth in Section 768.28, Florida Statutes.

ARTICLE 3 - CONTRACT DOCUMENTS: INTENT, AMENDING, REUSE

3.01 Intent:

The Contract Documents comprise the entire Agreement between the CITY and CONTRACTOR concerning the work. The Contract Documents can be altered only by Change Order. The Contract Documents are complementary; what is called for by one is as binding as if called for by all. It is the intent of the Contract Documents that the CONTRACTOR, for due consideration, shall furnish all equipment, material, supervision and labor, (except as may be specifically noted otherwise) required or necessary to complete the work in total accordance with said Documents. It is the intent of the Drawings and Specifications to describe the Project to be constructed in accordance with the Contract Documents. Any work that may reasonably be inferred from the Drawings or Specifications as being required to produce the intended result shall be supplied whether or not it is specifically called for.

3.02 Order of Precedence of Contract Documents:

In resolving differences resulting from conflicts, errors or discrepancies in any of the following Contract Documents, the order of precedence shall be as follows:

1. Permits
2. Change Orders
3. Contract Agreement
4. Specification
5. Drawings

Within the Specifications the order of precedence is as follows:

1. Addenda
2. Notice to Bidders
3. Instructions to Bidders
4. Supplementary General Conditions

5. General Conditions
6. Division 1, General Requirements
7. Technical Specifications
8. Referenced Standard Specifications

With reference to the Drawings the order of precedence is as follows:

1. Figures Govern over Scaled Dimensions
2. Detail Drawings Govern over General Drawings
3. Change Order Drawings Govern over Contract Drawings
4. Contract Drawings Govern over Standard or Shop Drawings

3.03 Reference to Standards:

Any reference to standard Specifications, manuals or codes of any organization or governmental authority shall mean the latest edition, in effect as of the Bid Opening Date.

ARTICLE 4 - AVAILABILITY OF LANDS; SUBSURFACE AND PHYSICAL CONDITIONS; HAZARDOUS ENVIRONMENTAL CONDITIONS; REFERENCE POINTS

4.01 Rights-of-Way:

Lands or Rights-of-Way for the work to be constructed under the Contract will be provided by the CITY. Nothing contained in the Contract Documents shall be interpreted as giving the CONTRACTOR exclusive occupancy of the lands or Rights-of-Way provided. Any additional lands or Rights-of-Way required for construction operations shall be provided by the CONTRACTOR at his own expense; provided, that the CONTRACTOR shall not; and the CITY nor the ENGINEER shall not be liable for any claims or damages resulting from the CONTRACTOR's unauthorized trespass or use of any such properties.

4.02 Permits:

When required by Article 21 of the Instruction to Bidders, the CONTRACTOR shall secure, from the agencies having jurisdiction, the necessary permits to create obstructions, to make excavations if required under the Contract, and to otherwise encroach upon Rights-of-Way, and to present evidence to the ENGINEER that such permission has been granted, before work is commenced. Regulations and requirements of all agencies concerned shall be strictly adhered to in the performance of the Contract. The enforcement of such requirements

under the Contract shall not be made the basis for additional compensation.

4.03 Lines and Grades:

The CONTRACTOR shall furnish all grades and all other lines required for the proper execution of the work.

ARTICLE 5 - BONDS AND INSURANCE

5.01 Bid Guarantee:

Bidders maybe required to submit a Bid Guarantee in an amount indicated in the NOTICE TO BIDDERS. This Guarantee may be a Certified or Cashier's Check on a solvent National or State Bank, or a Bid Bond written by a Surety licensed to do business in Florida and rated at least "A", Class X in the latest edition of "Best's Key Rating Guide" published by A.M. Best Company.

5.02 Performance and Payment Bond:

CONTRACTOR shall furnish Performance and Payment Bonds, in amounts equal to the Contract Price as Security for the faithful performance and payment of CONTRACTOR's obligations. The Bond or Bonds shall remain in effect one year after the date of final payment. The Surety must be qualified as specified above in Paragraph 5.1. However, the City reserves the right to require additional bonds as set forth in Article 5 of the Contract.

5.03 Signatures:

All Bonds signed by an Agent must be accompanied by a Certified copy of the authority to act, with said copy having been signed (not typed nor printed) by an Officer of the Surety and carrying the seal of the Surety.

5.04 Insurance Coverage:

Within ten days from Notice of Award the CONTRACTOR shall purchase and maintain such insurance as will protect him from claims set forth below which may arise out of or result from the CONTRACTOR's operations under the Contract or Contract Documents, whether such operations be by himself or by any Subcontractor or by anyone directly or indirectly employed by any of them, or by anyone for whose acts any of them may be liable:

- A. Claims under Workmen's Compensation, Disability Benefit and other similar employer's liability acts;
- B. Claims for damages because of bodily injury, sickness or disease, or death, or death of his employees;
- C. Claims for damages because of bodily injury, sickness or disease, or

death of any person other than his employees;

- D. Claims for damages covered by personal injury liability which are sustained (1) by any person as a result of any offense directly or indirectly related to the employment of such person by the CONTRACTOR, or (2) by any other person;
- E. Claims for damages, other than to the work itself, because of injury to or destruction of tangible property, including loss of use resulting therefrom; and
- F. Claims for damages because of bodily injury or death of any person or property damage arising out of the ownership, maintenance or use of any motor vehicle.
- G. **The insurance policy shall not contain any exceptions that would exclude coverage for risks that can be directly or reasonably related to the scope of goods or services in this bid/proposal. A violation of this requirement at any time during the term, or any extension thereof shall be grounds for the immediate termination of any contract entered in to pursuant to this bid/proposal. In order to show that this requirement has been met, along with an insurance declaration sheet demonstrating the existence of a valid policy of insurance meeting the requirements of this bid/proposal, the successful proposer must submit a signed statement from insurance agency of record that the full policy contains no such exception.**

5.05 Certificates of Insurance:

Within ten days of award, the Contractor shall obtain a Certificate of Insurance reflecting the necessary coverages as required by the Contract Documents. Certificates of Insurance shall contain a provision that coverages afforded under the policies will not be canceled until at least 30 days prior written notice has been given to the CITY. The City of Hollywood must be named as additional insured on all coverage with the exception of Workmen's Compensation. Policies shall be issued by companies authorized to do business under the Laws of the State of Florida. Policyholders and Financial Ratings must be no less than "A" and Class X respectively in the latest edition of "Best Key Rating Guide", published by A.M. Best Company.

5.06 Insurance Limits of Liability:

The insurance required by this Article shall be written for no less than the level of liability specified in "Insurance Requirements", Section 2 of the Supplementary General Conditions, or required by law, whichever is greater. The insurance shall include contractual liability insurance applicable to the CONTRACTOR's obligations under this contract.

The level required in Section 2 of the Supplementary General Conditions will not be reduced for any reason.

ARTICLE 6 - CONTRACTOR'S RESPONSIBILITIES

6.01 Laws/Regulations to Be Observed:

The CONTRACTOR shall familiarize himself and comply with all Federal, State, County and CITY laws, by-laws, ordinances or regulations controlling the action or operation of those engaged or employed in the work or affecting material used, and govern himself in accordance with them. He shall indemnify and save harmless the CITY and all of its officers, agents and employees against any claims or liability arising from or based on the violation of any such laws, by-laws, ordinances, regulations, orders or decrees, whether by himself or his employees or Subcontractors.

6.02 Indemnification of City:

- (a) CONTRACTOR shall, at all times hereafter, indemnify, hold harmless and defend CITY, its agents, servants and employees from and against any claim, demand or cause of action of any kind or nature arising out of error, omission or negligent act of CONTRACTOR, its agents, servants or employees in the performance of services under this Agreement.
- (b) CONTRACTOR further agrees, at all times hereafter, to indemnify, hold harmless and defend CITY, its agents, servants and employees from and against any claim, demand or cause of action of any kind or nature arising out of any conduct or misconduct of CONTRACTOR resulting from the performance of services under the Contract Documents.
- (c) The obligations of the CONTRACTOR above shall not extend to the liability of the City of Hollywood.
- (d) The provisions of (a) and (b) above shall survive the expiration or earlier termination of the Contract Documents.

6.03 Guarantee of Payments:

The CONTRACTOR guarantees the payments of all just claims for materials, supplies, tools, labor and other just claims against him, or any Subcontractor in connection with this Contract, and his bond will not be released by final acceptance and payment by the CITY unless all such claims are paid or released.

6.04 Permits and Licenses:

The CONTRACTOR shall obtain all permits and licenses required by the

Contract Documents. A copy of the permit(s) and such conditions and requirements thereon are a part of the Contract Documents. Failure to obtain such permits or licenses shall subject the CONTRACTOR to the provisions of the South Florida Building Code, Broward Edition.

6.05 Emergencies:

In emergencies affecting the safety or protection of persons or the work or property at the site or adjacent thereto, CONTRACTOR, without special instruction or authorization from ENGINEER or CITY, is obligated to act to prevent threatened damage, injury or loss. CONTRACTOR shall give ENGINEER prompt written notice of any significant changes in the work or deviations from the Contract Documents caused thereby.

6.06 Substitutes or "Or Equal":

A. Substitutes or "Or-Equal" Materials or Equipment:

Whenever materials or equipment are specified or described in the Contract Documents by using the name of a proprietary item or the name of a particular supplier the naming of the item is intended to establish the type, function and quality required. Unless the name is followed by words indicating that no substitution is permitted, materials or equipment of other Suppliers may be accepted by the ENGINEER if sufficient information submitted by the CONTRACTOR to allow the ENGINEER to determine that the material or equipment proposed is equivalent or equal to that named. The ENGINEER will be allowed 30 days within which to evaluate each proposed substitute. The ENGINEER will be the sole judge of acceptability, and NO SUBSTITUTE WILL BE ORDERED, INSTALLED OR UTILIZED WITHOUT THE ENGINEER'S PRIOR WRITTEN ACCEPTANCE which will be evidenced by either a Change Order or an approved set of Shop Drawings. Requests for review of substitute items of material and equipment will not be accepted by the ENGINEER from anyone other than the CONTRACTOR. The procedure for review by the ENGINEER is as follows:

If the CONTRACTOR wishes to furnish or use a substitute item of material or equipment, the CONTRACTOR shall make written application to the ENGINEER for acceptance thereof, certifying that the proposed substitute will perform adequately the functions and achieve the results called for by the general design, be similar and of equal substance to that specified and be suited to the same use as that specified. In addition, the application shall

1. State that the evaluation and acceptance of the proposed substitute will not prejudice the CONTRACTOR's achievement of completion on time.

2. State whether or not acceptance of the substitute for use in the WORK will require a change in any of the Contract Documents to adapt design to the proposed substitute. The CONTRACTOR shall be responsible for any extra design adaptation costs associated with a proposed substitute.
 3. State whether or not incorporation or use of the substitute in connection with the work is subject to payment of any license fee or royalty.
 4. Provide complete substitute identification and description, including manufacturer's and local distributor's name and address, performance and test data, and reference standards.
 5. Provide samples, as required by ENGINEER.
 6. Provide name and address of similar projects on which the proposed substitute has been used, and date of installation.
 7. Identify all variations of the proposed substitute from that specified.
 8. Indicate available maintenance, repair and replacement service.
 9. Submit an itemized estimate of all costs that will result directly or indirectly from acceptance of such substitute, including costs of redesign and claims of other Contractors affected by the resulting change. The CONTRACTOR shall be responsible for the costs of redesign and claims of other Contractors.
 10. Provide any additional data about the proposed substitute as the ENGINEER may require of the CONTRACTOR.
- B. Substitute means, method, technique, sequence or procedure of construction:
- If a specific means, method, technique, sequence or procedure of construction is indicated in or required by the Contract Documents, the CONTRACTOR may furnish or utilize a substitute means, method, sequence, technique or procedure of construction acceptable to the ENGINEER, if the CONTRACTOR submits sufficient information to allow the ENGINEER to determine that the substitute proposed is equivalent to that indicated or required by the Contract Documents. The procedure for review by the ENGINEER will be similar to that provided in Paragraph 7.6 A.
- C. The CITY may require the CONTRACTOR to furnish at the CONTRACTOR's expense, a special performance guarantee or other surety with respect to any substitute.

- D. The ENGINEER will record time required by the ENGINEER and/or the ENGINEER's consultants in evaluating substitutions proposed by the CONTRACTOR and in making changes in the Contract Documents occasioned thereby. Whether or not the ENGINEER accepts a proposed substitute, THE CONTRACTOR SHALL REIMBURSE THE CITY FOR THE CHARGES OF THE ENGINEER AND THE ENGINEER's CONSULTANTS FOR EVALUATING EACH PROPOSED SUBSTITUTE.
- E. Any and all costs which result from changes to/adaptations of the work shall be paid by the CONTRACTOR including but limited to design, materials, installation, etc.

6.07 Shop Drawings:

Shop Drawing submittals shall be as follows:

- A. The CONTRACTOR shall submit a sufficient number of copies of each Shop Drawing to enable the ENGINEER to retain three copies unless additional copies are specified in the Contract Documents. Resubmissions of Shop Drawings shall be made in the same quantity until final approval is obtained.
- B. The CONTRACTOR shall submit Shop Drawings for all equipment, apparatus, machinery, fixtures, piping, fabricated structures, manufactured articles and structural components Manufacturer's Certified Affidavit that the item supplied complies with the design Specifications, and all other submittal requirements.
- C. Shop Drawings for structural components, electrical or mechanical systems shall be certified by a Registered Engineer of the discipline involved.
- D. The CONTRACTOR shall thoroughly review and check the Shop Drawings, and each and every copy shall show his approval thereon. If the Shop Drawings show or indicate departures from the Contract requirements, the CONTRACTOR shall make specific mention thereof in his letter of transmittal. Failure to point out such departures shall not relieve the CONTRACTOR from his responsibility to comply with the Drawings and Specifications.
- E. No approval will be given to partial submittals of Shop Drawings for items which interconnect and/or are interdependent. It is the CONTRACTOR's responsibility to assemble the Shop Drawings for all such interconnecting and/or interdependent items, check them himself and then make one submittal to the ENGINEER along with his comments as to compliance, non-compliance, or features requiring special attention.
- F. If catalog sheets or prints of manufacturer's standard drawings are

submitted as Shop Drawings, any additional information or changes on such Drawings shall be typewritten or lettered in ink.

- G. The CONTRACTOR shall keep one set of Shop Drawings marked with the ENGINEER's approval at the job site at all times.
- H. Where a Shop Drawing or sample is required by the Specifications, no related work shall be commenced until the submittal has been reviewed and approved by the ENGINEER.
- I. Approval of the Shop Drawings shall constitute approval of the subject matter thereof only, and not of any structure, material, equipment or apparatus shown or indicated. The approval of the Shop Drawings will be general and shall not relieve the CONTRACTOR of responsibility for the accuracy of such Drawings, nor for the proper fitting and construction of the work, nor for the furnishing of materials or work required by the contract and not indicated on the Drawings. Approval shall not relieve the CONTRACTOR from responsibility for errors or omissions of any sort on the Shop Drawings.

6.08 Personnel:

A. Supervision and Superintendence:

- 1. The CONTRACTOR shall supervise and direct the work competently and efficiently, devoting such attention thereto and applying such skills and expertise as may be necessary to perform the work in accordance with the Contract Documents. The CONTRACTOR shall be solely responsible for the means, methods, techniques, sequences and procedures of construction, but the CONTRACTOR shall not be solely responsible for the negligence of others in the design or selection of a specific means, method, technique, sequence or procedure of construction which is indicated in and required by the Contract Documents. The CONTRACTOR shall be responsible to see that the finished work complies accurately with the Contract Documents.
- 2. The CONTRACTOR shall keep on the work at all times during its progress a competent resident Superintendent fluent in both oral and written communication in the English language, who shall not be replaced without written notice to the ENGINEER except under extraordinary circumstances. The Superintendent will be the CONTRACTOR's representative at the site and shall have authority to act on behalf of the CONTRACTOR. All communications given to the Superintendent shall be as binding as if given to the CONTRACTOR.

B. Workforce:

1. None but skilled workers shall be employed on work requiring special qualifications. When required in writing by the ENGINEER, the CONTRACTOR or any Subcontractor shall discharge any person who is, in the opinion of the ENGINEER, incompetent, disorderly or otherwise unsatisfactory, and shall not again employ such discharged person on the work except with the consent of the ENGINEER. Such discharge shall not be the basis of any claim for damages against the CITY or any CITY agents.
2. With respect to all skilled, semi-skilled and unskilled workers employed on the Project under this Contract, preference in employment shall be given to persons residing in Hollywood when such persons are available and qualified to perform the work to which the employment relates. No person shall be employed in violation of the State or National Labor Laws. No person under the age of 16 years shall be employed on a Project under the Contract. No person whose age or physical condition is such as to make his employment dangerous to his health or safety or to the health or safety of others shall be employed on the Project under this Contract; provided that this shall not operate against the employment of physically handicapped persons, otherwise employable where such persons may be safely assigned to work which they can ably perform. No person currently serving sentences in a penal or correctional institution and no inmate of an institution for mentally defective shall be employed on a Project under this Contract without specific approval of the ENGINEER.
3. No discrimination shall be made in the employment of persons on the work by the CONTRACTOR or by any Subcontractor under him, because of the race, color, sex, age or religion of such persons, and there shall be full compliance with the provisions of applicable State and Federal laws in this regard.

6.09 Safety and Protection:

A. Federal Safety and Health Regulations:

The CONTRACTOR and Subcontractors shall comply with the provisions of the Occupational Safety and Health Standards, promulgated by the Secretary of Labor under the "Occupational Safety and Health Act of 1970".

B. Responsibilities:

The CONTRACTOR shall be responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the

work. The CONTRACTOR shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury or loss to:

1. All employees on the work and other persons who may be affected thereby.
2. All the work and all materials or equipment to be incorporated therein, whether in storage on or off the site.
3. Other property at the site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures and utilities not designated for removal, relocating or replacement in the course of construction.

C. Designated Safety Officer:

The CONTRACTOR shall designate a responsible member of his organization at the site whose duty shall be the prevention of accidents. This person shall be the CONTRACTOR's Superintendent unless otherwise designated in writing by the CONTRACTOR to the ENGINEER.

D. Protection of the Work:

Until acceptance of the work by the CITY, it shall be under the charge and in care of the CONTRACTOR and he shall take every necessary precaution against injury or damage to the work by action of the elements or from the execution or from the non-execution of the work. The CONTRACTOR shall rebuild, restore and make good, at his own expense, all injuries or damages to any portion of the work occasioned by any of the above causes before its completion and acceptance.

6.10 Traffic Control, Public Safety and Convenience:

- A. The CONTRACTOR shall at all times conduct his work so as to assure the least possible obstruction to traffic and inconvenience to the general public, and provide adequate protection of persons and property in the vicinity of the work.
- B. WHEN THE NORMAL FLOW OF TRAFFIC WILL BE IMPAIRED OR DISRUPTED IN ANY MANNER ON ANY STREET, THE CONTRACTOR SHALL NOTIFY THE POLICE TRAFFIC SERGEANT AT 921-3610 AT LEAST 48 HOURS IN ADVANCE.
- C. Streets shall not be closed, except when and where directed by the ENGINEER, and whenever a street is not closed the work must be conducted with the provision for safe passageway for traffic at all times. The CONTRACTOR shall make all necessary arrangements concerning

maintenance of traffic and selection of detours required.

- D. When permission has been granted to close an existing roadway, or portion thereof, the CONTRACTOR shall furnish and erect signs, barricades, lights, flags and other protective devices as necessary subject to the approval of the ENGINEER. From sunset to sunrise, the CONTRACTOR shall furnish and maintain as many yellow lights as the ENGINEER may direct.
- E. During working hours the CONTRACTOR shall furnish watchmen in sufficient numbers to protect and divert the vehicular and pedestrian traffic from working areas closed to traffic, or to protect any new work. Failure to comply with this requirement will result in the ENGINEER shutting down the work until the CONTRACTOR shall have provided the necessary protection.
- F. No separate payment will be made for such signs, barricades, lights, flags, watchmen or other protective devices as required, with all costs thereof deemed to be included in the prices bid for the various items scheduled in the bid.
- G Sidewalks, gutters, drains, fire hydrants and private drives shall, insofar as practicable, be kept in condition for their intended uses. While the work is actually going on at any location, as much as half the street width at that location may be barricaded to exclude traffic entirely, but street traffic shall not be obstructed needlessly. Fire hydrants on or adjacent to the work shall be kept accessible to fire apparatus at all times, and no material or obstruction shall be placed within ten feet of any such hydrant.
- H. Construction material stored upon the public street shall be placed so as to cause as little obstruction to the general public as is reasonably possible.

6.11 Use of Explosives:

When the use of explosives is necessary for the prosecution of the work, the CONTRACTOR shall observe the utmost care so as not to endanger life or property, and whenever directed, the number and size of charges shall be limited. All explosives shall be stored in a secure manner and all such storage places shall be marked clearly "DANGEROUS EXPLOSIVES" and shall be in care of a competent watchman at all times. The CONTRACTOR must familiarize himself with all laws and ordinances pertaining thereto, and govern himself and his employees accordingly.

6.12 Loading of Structures:

The CONTRACTOR shall not load nor permit any part of any structure to be loaded in any manner that will endanger the structure, nor shall the CONTRACTOR subject any part of the work or adjacent property to stresses or pressures that will endanger it.

6.13 Concerning Subcontractors:

- A. The CONTRACTOR, with his own forces, shall perform no less than 25% of the work as determined by the Contract price. Each Subcontractor shall be properly licensed for the type of work he is to perform.
- B. A copy of each Sub-Contract shall be filed promptly with the ENGINEER upon request. Each Sub-Contract shall contain a reference to the Contract between the CITY and the CONTRACTOR, and the terms and conditions of the Contract shall be made a part of each Sub-Contract. Each Sub-Contract shall provide for annulment of same by the CONTRACTOR upon written order of the ENGINEER if the Subcontractor fails to comply with the requirements of this Contract.
- C. The CONTRACTOR shall be responsible to the CITY and ENGINEER for the acts and omissions of his Sub- Contractors and their employees to the same extent as he is responsible for the acts and omissions of his own employees. Nothing contained in this Contract shall create any contractual relationship between any Subcontractor and the CITY or ENGINEER nor relieve the CONTRACTOR of any liability or obligation under this Contract.

6.14 Materials and Equipment:

- A. Material for the Work:
 - 1. The CONTRACTOR shall furnish all materials, equipment, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water and sanitary facilities and all other facilities and incidentals necessary for the execution, testing, initial operation and completion of the work.
 - 2. Unless otherwise specified, shown or permitted by the ENGINEER, all material and equipment incorporated in the work shall be new and of current manufacture. The ENGINEER may request the CONTRACTOR to furnish manufacturer's certificates to this effect.
 - 3. The ENGINEER may require any or all materials to be subjected to test by means of samples or otherwise, at production points or after delivery. The CONTRACTOR shall afford such facilities as the ENGINEER may require for collecting and forwarding samples, which samples shall be furnished by the CONTRACTOR without charge.

The CONTRACTOR shall furnish evidence satisfactory to the ENGINEER that the materials and finished articles have passed the required test prior to the incorporation of such materials and finished articles in the work. Unless otherwise provided, the cost of such inspection and testing shall be as provided in Article 12.2.

4. All packaged manufactured products for use on the work shall be delivered to the work in their original, unopened packages, bearing thereon the manufacturer's name and the brand name of the product.
5. Wherever any product or material is selected to be used on the work, all such products or material shall be of the same brand and manufacture throughout the work.
6. All equipment, tools and machinery used for handling material or executing any part of the work shall be maintained in a satisfactory working condition. All equipment utilized on any portion of the work shall be such that no injury to personnel, the work, adjacent property or other objects will result from its use.
7. All materials and equipment shall be applied, installed, connected, erected, used, cleaned and conditioned in accordance with the instructions of the applicable manufacturer, fabricator, supplier or distributor, except as otherwise provided in the Contract Documents.

B. Storage of Materials:

1. All materials and equipment including that ordered by the CITY designed for permanent installation in the work shall be properly stored by the CONTRACTOR to insure protection against deterioration of any type. These materials shall be placed as to cause a minimum of inconvenience to other contractors on the work and to the public. The storage piles shall be arranged to facilitate inspections, and any deterioration shall be grounds for rejection.
2. Materials stored in public Rights-of-Way, shall be stored in such a manner so as to be compatible with the Traffic Control requirements set forth in Paragraph 7.10. Materials shall be stored so as not to deny access to public or private property. Stored materials shall be adequately marked with barricades and/or flashing warning lights, where necessary, so as to protect the materials from damage and to protect the public health, safety and welfare.
3. Lawns, grass plots or other private property shall not be used for storage purposes without written permission of the CITY or Lessee of that private property. Should the CONTRACTOR desire to store equipment or materials of any kind on the property of the CITY, he must obtain permission from the ENGINEER. The CITY reserves the

right to order materials to be removed or relocated in such approved storage areas, if necessary.

4. The protection of stored materials shall be the CONTRACTOR's responsibility and the CITY OF HOLLYWOOD shall not be liable for any loss of materials, by theft or otherwise, nor for any damage to the stored materials.

C. Salvage of Materials and Equipment:

The CITY reserves the right to retain title to all soil, sand, stone, gravel, equipment, machinery or any other material that was a part of the structure, site or Right- of-Way and which was developed from excavations or other operations connected with the work. The CONTRACTOR will be permitted to use in the work, without charge, any such material which meets the requirements of the Contract Documents. For that material which the CITY desires to retain the CONTRACTOR shall, at his expense, transfer to a site within the CITY as designated by the ENGINEER. That material which the CITY does not wish to retain shall be the property of the CONTRACTOR and removed from the site at CONTRACTOR's expense.

6.15 Temporary Utilities:

The CONTRACTOR shall provide and maintain at his own expense, all water, power, telephone and sanitary facilities as required to comply with State and/or local Codes and Regulations. If water, including that for testing is required, it is the CONTRACTOR's responsibility to arrange through the CITY Water Department for a water meter. A deposit to be paid by the CONTRACTOR is required for meter rental and all water shall be purchased at the prevailing rate.

6.16 Review of Records:

The CONTRACTOR shall allow and permit the ENGINEER or his duly authorized representative to inspect and review all payrolls, records of personnel, conditions of employment, invoice of materials, books of accounts and other relevant data and records pertinent to the CONTRACT and Sub-Contracts.

6.17 Use of Premises:

CONTRACTOR shall confine construction equipment, the storage of materials and equipment and the operations of workmen to areas permitted by law, ordinances, permits or required by the Contract Documents, and shall not interfere with the premises or operation of the City Utilities facilities with construction equipment or other materials or equipment. Construction which interferes with Plant Operations shall be fully coordinated and approved by the ENGINEER.

6.18 CONTRACTOR's Daily Reports:

Except where otherwise provided, the CONTRACTOR shall complete a daily report indicating manpower, major equipment, Subcontractors, etc., involved in the performance of the work. The daily report shall be completed on forms approved by the ENGINEER, and shall be submitted to the ENGINEER at the conclusion of each work day.

6.19 Record Documents:

The CONTRACTOR shall keep one record copy of all Specifications, Drawings, Addenda, Modifications, Shop Drawings and samples at the site, in good order and annotated to show all changes made during the construction process. These shall be available to ENGINEER for examination and shall be delivered to ENGINEER upon completion of the work.

6.20 Cleanliness of the Site:

During the progress of the work, The CONTRACTOR shall keep the premises free from accumulations of waste materials, rubbish and other debris resulting from the work. At the completion of the work the CONTRACTOR shall remove all waste materials, rubbish and debris from and about the premises as well as all tools, appliances, construction equipment and machinery and surplus materials, and shall leave the site clean and ready for occupancy by the CITY. The CONTRACTOR shall restore to their original condition those portions of the site not designated for alteration by the Contract Documents.

6.21 Dust Control:

It shall be the CONTRACTOR's responsibility to control dust by watering as directed by the ENGINEER. The water used shall be paid for by the CONTRACTOR. Should the CONTRACTOR fail to control dust to the satisfaction of the ENGINEER, the CITY will control the dust by whatever means the CITY desires and the CONTRACTOR shall pay all expenses incurred by the CITY associated with the control of the dust.

6.22 Continuing the Work:

The CONTRACTOR shall carry on the work and maintain the Progress Schedule during all disputes or disagreements with the CITY. No work shall be delayed or postponed pending resolution of any disputes or disagreements, except as the CONTRACTOR and the CITY may otherwise agree in writing.

6.23 Indemnification:

In consideration of the amount listed in the Schedule of Prices Bid and other valuable consideration, the Contractor shall defend, indemnify and save harmless the CITY, its officers, agents, and employees from or on account of any

personal injury, loss of life or damage to property received or sustained by any person or persons during or on account of any operations connected with the construction of this Project; or by or in consequence of any negligence (excluding negligence of the CITY), in connection with the same; or by use of any improper materials or by or on account of any use of any improper materials or by or on account of any act or omission of the said Contractor or his subcontractor, agents, servants or employees. Contractor agrees to indemnify and save harmless the CITY against any liability arising from or based upon the violation of any federal, state, county or city laws, by-laws, ordinances or regulations by the Contractor, his subcontractor, agents, servants or employees. Contractor further agrees to indemnify and save harmless the CITY from all such claims and fees, and from any and all suits and actions of every name and description that may be brought against the CITY on account of any claims, fees, royalties, or costs for any invention or patent, and from any and all suits and actions that may be brought against the CITY for the infringement of any and all patents or patent rights claimed by any person, firm, or corporation.

The indemnification provided above shall obligate the Contractor to defend at his own expense or to provide for such defense, at the CITY's option, any and all claims or liability and all suits and actions of every name and description that may be brought against the CITY which may result from the operations and activities under this Contract whether the construction operations be performed by the Contractor, his subcontractor or by anyone directly or indirectly employed by either.

Nothing in this indemnification shall be deemed to affect the rights, privileges or immunities of the CITY as set forth in Section 768.28, Florida Statutes.

The CITY will pay to the Contractor the specific consideration, in the amount stated in the Schedule of Prices Bid. The Contractor shall acknowledge the receipt of payment and other good and valuable consideration from the CITY which has been paid to him as specific consideration for the indemnification provided herein and in accordance with the provisions of Chapter F.S.A., Section 725.06.

ARTICLE 7 - OTHER WORK AT THE SITE

7.01 Related Work at Site

- A. City may perform other work related to the Project at the Site with City's employees, or through other direct contracts therefore, or have other work performed by utility owners. If such other work is not noted in the Contract Documents, then:
 - 1. written notice thereof will be given to Contractor prior to starting any such other work; and

2. if City and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times that should be allowed as a result of such other work, a Claim may be made therefor as provided in Paragraph 10.05.
- B. Contractor shall afford each other contractor who is a party to such a direct contract, each utility owner and City, if City is performing other work with City's employees, proper and safe access to the Site, provide a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such other work, and shall properly coordinate the Work with theirs. Contractor shall do all cutting, fitting, and patching of the Work that may be required to properly connect or otherwise make its several parts come together and properly integrate with such other work. Contractor shall not endanger any work of others by cutting, excavating, or otherwise altering such work; provided, however, Contractor may cut or alter the work of others with the written consent of Engineer and the others whose work will be affected. The duties and responsibilities of Contractor under this Paragraph are for the benefit of such utility owners and other contractors to the extent that there are comparable provisions for the benefit of Contractor in said direct contracts between City and such utility owners and other contractors.
 - C. If the proper execution or results of any part of Contractor's Work depends upon work performed by others under this Article 7, Contractor shall inspect such other work and promptly report to Engineer in writing any delays, defects, or deficiencies in such other work that render it unavailable or unsuitable for the proper execution and results of Contractor's Work. Contractor's failure to so report will constitute an acceptance of such other work as fit and proper for integration with Contractor's Work except for latent defects and deficiencies in such other work.

ARTICLE 8 - CITY'S RESPONSIBILITIES

8.01 Communications:

The CITY shall issue all communications to the CONTRACTOR through the ENGINEER.

8.02 Furnish Contract Documents:

The CITY shall furnish the number of Contract Documents as specified in the Supplementary General Conditions to the CONTRACTOR at no cost. Referenced Standard Specifications Manuals, guidebooks, etc., will not be provided.

8.03 Furnish Right-of-Way:

The CITY shall furnish the necessary land or Right-of-Way on which the work is

to be accomplished, and will provide lines and grades as specified in Article 6.

8.04 Timely Delivery of Materials:

The CITY shall be responsible for the delivery of any CITY furnished material, equipment or labor as specified in the Contract Documents.

ARTICLE 9 - ENGINEER'S STATUS DURING CONSTRUCTION

9.01 Authority of the Engineer:

- A. The general supervision of the execution of this Contract is vested in the ENGINEER who is the CITY's sole representative during the construction period. The instructions of the ENGINEER are to be strictly and promptly followed in every case. The CONTRACTOR's representative (Article 7.8 A. 1.) shall be responsible for the execution of any instructions given by the ENGINEER during the absence of the CONTRACTOR.
- B. The ENGINEER is the initial interpreter of the requirements of the Contract Documents and judge of the acceptability of the work. Claims, disputes and other matters relating to the acceptability of work or requirements of the Contract Documents shall be referred in writing to the ENGINEER within 15 days of the event, with a request for a formal decision, which the ENGINEER will render in writing within a reasonable time. This rendering of a decision by the ENGINEER will be a condition precedent to any exercise by the CITY or CONTRACTOR of rights or remedies as either may otherwise have under the Contract Documents or at law in respect to any such claim, dispute or other matter.
- C. The ENGINEER will issue with reasonable promptness any written clarifications or interpretations of the Contract Documents as he shall deem necessary, which shall be consistent with or reasonably inferable from the overall intent of the Contract Documents. If, as a result of a clarification or interpretation, either the CONTRACTOR or ENGINEER believes a Change Order is justified, it shall be submitted.
- D. The ENGINEER has approval authority over the acceptability of all material or equipment furnished, Shop Drawings, Change Orders, work performed and the rate of progress of the work. Verification of the quantities of work performed for pay purposes is the responsibility of the ENGINEER.
- E. The ENGINEER also has the authority to disapprove or reject work which is defective, and may require special inspection or testing of the work, whether or not it is fabricated, installed or completed.
- F. The ENGINEER has the authority to suspend the work wholly or in part for

such period or periods as may be deemed necessary, due to the unsuitable prosecution of the work, or for such time as is necessary due to failure on the part of the CONTRACTOR to carry out orders given or perform any or all provisions of the Contract. The CONTRACTOR shall not suspend the work and shall not remove any equipment, tools, lumber or other materials without the written permission of the ENGINEER.

9.02 Access to the Work:

The ENGINEER is to have free access to the materials and work at all times for laying out, measuring or inspecting same, and the CONTRACTOR is to afford him all necessary facilities and assistance for so doing.

9.03 Limitations on the ENGINEER's Responsibilities:

- A. Neither the ENGINEER's authority to act under this Article or elsewhere in the Contract Documents nor any decision made by the ENGINEER in good faith either to exercise or not exercise such authority shall give rise to any duty or responsibility of the ENGINEER to the CONTRACTOR, any Subcontractor, any manufacturer, fabricator, supplier or distributor or any of their agents or employees or any other person performing any of the work.
- B. Whenever in the Contract Documents the terms "as ordered", "as directed", "as required", "as allowed" or terms of like effect or import are used, or the adjectives "reasonable", "suitable", "acceptable", "proper" or "satisfactory" or adjectives of like effect or import are used, to describe requirement, direction, review or judgment of the ENGINEER as to the work, it is intended that such requirement, direction, review or judgment will be solely to evaluate the work for compliance with the Contract Documents (unless there is a specific statement indicating otherwise). The use of any such term or adjective never indicates that the ENGINEER has authority to supervise or direct performance of the work.
- C. The ENGINEER will not be responsible for the CONTRACTOR's means, methods, techniques, sequences or procedures of construction, nor the safety precautions and programs incident thereto, and the ENGINEER will not be responsible for the CONTRACTOR's failure to perform the work in accordance with the Contract Documents.
- D. The ENGINEER will not be responsible for the acts or omissions of the CONTRACTOR or of any Subcontractors, or of the agents or employees of any CONTRACTOR or subcontractor, or of any other persons at the site or otherwise performing any of the work.

9.04 Inspectors:

- A. Inspectors employed by the CITY assist the ENGINEER in ascertaining

the work conforms to the Contract Documents and are authorized to inspect all work done and material furnished as representatives of the ENGINEER. Inspectors shall be stationed at the site of the work to report to the ENGINEER as to the progress of the work and the quality of workmanship and material.

- B. In case of any dispute arising between the CONTRACTOR and the Inspector, the Inspector shall have the authority to reject material or to suspend the work until the question of issue can be referred to and decided upon by the ENGINEER.
- C. If the CONTRACTOR refuses to suspend operation on verbal order, the Inspector shall issue a written order giving the reason for shutting down the work. After placing the order in the hands of the man in charge, the Inspector shall immediately leave the job. Work done during the absence of the Inspector, after such written notice, will not be accepted nor paid for.
- D. Inspectors are not authorized to revoke, alter, enlarge, relax or release any requirements of these Contract Documents, nor to issue instructions contrary to them. Inspectors shall in no case act as foreman or perform other duties for the CONTRACTOR, nor interfere with management of the work by the latter. Any instructions which Inspectors may give the CONTRACTOR shall in no way be construed as releasing the CONTRACTOR from fulfillment of the terms of the Contract.
- E. The payment of any compensation, whatever may be its character or form, or the giving of any gratuity, or the granting of any valuable favor, by the CONTRACTOR to any Inspector, directly or indirectly, is strictly prohibited and any such act on the part of the CONTRACTOR will constitute a violation of this Contract and may subject the CONTRACTOR to other penalties provided for by law or ordinance.

9.05 Inspections:

- A. The ENGINEER will make, or have made, such inspections and tests as he deems necessary to assure that the work is being accomplished in accordance with the requirements of the Contract. In the event such inspections or tests reveal non-compliance with the requirements of the Contract, the CONTRACTOR shall bear the cost of such corrective measures as well as the cost of subsequent reinspection and retesting.
- B. Work done in the absence of a prescribed inspection may be required to be removed and replaced under proper inspection. The entire cost of removal and replacement, including the cost of all material which may be furnished by the CITY and used in the work thus removed, shall be borne by the CONTRACTOR, regardless of whether the work removed is found to be defective or not. Work covered up without the authority of the ENGINEER, shall, upon order of the ENGINEER, be uncovered to the

extent required, and the CONTRACTOR shall similarly bear the entire cost of performing all the work and furnishing all the material necessary for the removal of the covering and its subsequent replacement.

- C. Unless otherwise provided, the cost of inspection and all inspection fees imposed by public agencies other than the fees associated with the issuance of the Master Building Permit by the City of Hollywood shall be paid by the CONTRACTOR.
- D. No inspection nor any failure to inspect at any time or place shall relieve the CONTRACTOR from any obligation to perform all of the work in strict conformance with the requirements of the Contract Documents.

ARTICLE 10 - CHANGES IN THE WORK/CONTRACT PRICE

10.01 Changes in the Work or Terms of Contract Documents:

- A. Without invalidating the Contract and without notice to any surety CITY reserves and shall have the right, from time to time to make such increases, decreases or other changes in the character or quantity of the Work as may be considered necessary or desirable to complete fully and acceptably the proposed construction in a satisfactory manner. Any extra or additional work within the scope of this Project must be accomplished by means of appropriate Clarifications, Field Orders, or Change Orders.
- B. Any changes to the terms of the Contract Documents must be contained in a written document, executed by the parties hereto, with the same formality and of equal dignity prior to the initiation of any work reflecting such change.

This section shall not prohibit the issuance of Change Orders executed only by CITY as hereinafter provided.

10.02 Supplemental Instructions - Clarifications:

- A. The CITY, through the ENGINEER, shall have the right to approve and issue Clarifications setting forth written interpretations of the intent of the Contract Documents and ordering minor changes in Work execution, providing the Clarifications involve no change in the Contract Price or the Contract Time.
- B. The ENGINEER shall have the right to approve and issue Clarifications setting forth written orders, instructions, or interpretations concerning the Contract Documents or its performance, provided such Clarifications involve no change in the Contract Price or the Contract Time.

10.03 Field Orders / Change Orders:

- A. Changes in the quantity or character of the Work within the scope of the Project which are not properly the subject of Clarifications, including all changes resulting in changes in the Contract Price or the Contract Time, shall be authorized only by Field Orders or Change Orders approved in advance and issued in accordance with the provisions of the CITY Procurement Code, as amended from time to time.
- B. CONTRACTOR shall not start work on any changes requiring an increase in the Contract Price or the Contract Time until a Field Order or Change Order setting forth the adjustments is approved by the CITY. Upon receipt of a Change Order CONTRACTOR shall promptly proceed with the work set forth within the document.
- C. Field Orders shall be issued for change in Contract Price related to Cost Allowances specifically included on the Proposal Bid Form. Change Orders shall be issued when required for all other Contract Price Changes. Hereinafter, the term "Change Order(s)" shall be used to include "Change Orders" and "Field Orders" with the exception that Field Order shall not be used for any Contract Time adjustments.
- D. In the event satisfactory adjustment cannot be reached for any item requiring a change in the Contract Price or Contract Time, and a Change Order has not been issued, CITY reserves the right at its sole option to either terminate the Contract as it applies to the items in question and make such arrangements as may be deemed necessary to complete the disputed work; or the work shall be performed on the "cost of work" basis as described in Article 10.4.
- E. On approval of any Contract change increasing the Contract Price, CONTRACTOR shall ensure that the performance bond and payment bond are increased so that each reflects the total Contract Price as increased.
- F. Under circumstances determined necessary by CITY, Change Orders may be issued unilaterally by CITY.

10.04 Value of Change Order Work:

- A. The value of any work covered by a Change Order or of any claim for an increase or decrease in the Contract Price shall be determined in one of the following ways:
 - A.1 Where the work involved is covered by unit prices contained in the Contract Documents, by application of unit prices to the quantities of items involved, subject to the provisions of Article 10.4.G.

- A.2 By mutual acceptance of a lump sum which CONTRACTOR and CITY acknowledge contains a component for overhead and profit.
- A.3 On the basis of the "cost of work," determined as provided in this Article, plus a CONTRACTOR's fee for overhead and profit which is determined as provided in Article 10.4.D.
- B. The term "cost of work" means the sum of all direct costs necessarily incurred and paid by CONTRACTOR in the proper performance of the Work described in the Change Order. Except as otherwise may be agreed to in writing by CITY, such costs shall be in amounts no higher than those prevailing in the locality of the Project, shall include only the following items and shall not include any of the costs itemized in Article 10.4.C.
 - B.1 Payroll costs for employees in the direct employ of CONTRACTOR in the performance of the work described in the Change Order under schedules of job classifications agreed upon by CITY and CONTRACTOR. Payroll costs for employees not employed full time on the work covered by the Change Order shall be apportioned on the basis of their time spent on the work. Payroll costs shall include, but not be limited to, salaries and wages plus the cost of fringe benefits which shall include social security contributions, unemployment, excise and payroll taxes, workers' or workmen's compensation, health and retirement benefits, bonuses, sick leave, vacation and holiday pay application thereto. Such employees shall include superintendents and foremen at the site. The expenses of performing the work after regular working hours, on Sunday or legal holidays shall be included in the above to the extent authorized by CITY.
 - B.2 Cost of all materials and equipment furnished and incorporated in the work, including costs of transportation and storage thereof, and manufacturers' field services required in connection therewith. All cash discounts shall accrue to CONTRACTOR unless CITY deposits funds with CONTRACTOR with which to make payments, in which case the cash discounts shall accrue to CITY. All trade discounts, rebates and refunds, and all returns from sale of surplus materials and equipment shall accrue to CITY and CONTRACTOR shall make provisions so that they may be obtained. Rentals of all construction equipment and machinery and the parts thereof whether rented from CONTRACTOR or others in accordance with rental agreements approved by CITY with the advice of ENGINEER and the costs of transportation, loading, unloading, installation, dismantling and removal thereof, all in accordance with the terms of said agreements. The rental of any such equipment, machinery or parts shall cease when the use thereof is no longer necessary for the work.

B.3 Payments made by CONTRACTOR to Subcontractors for work performed by Subcontractors, If required by CITY, CONTRACTOR shall obtain competitive bids from Subcontractors acceptable to CONTRACTOR and shall deliver such bids to CITY who will then determine, with the advice of ENGINEER, which bids will be accepted. If the Subcontract provides that the Subcontractor is to be paid on the basis of cost of the work plus a fee, the Subcontractor's cost of the work shall be determined in the same manner as CONTRACTOR'S cost of the work. All Subcontractors shall be subject to the other provisions of the Contract Documents insofar as applicable.

B.4 Cost of special engineers, including, but not limited to, engineers, architects, testing laboratories, and surveyors employed for services specifically related to the performance of the work described in the Change Order.

B.5 Supplemental costs including the following:

The proportion of necessary transportation, travel and subsistence expenses of CONTRACTOR's employees incurred in discharge of duties connected with the work except for local travel to and from the site of the work.

Cost, including transportation and maintenance, of all materials, supplies, equipment, machinery, appliances, office and temporary facilities at the site and hand tools not owned by the workmen, which are consumed in the performance of the work, and cost less market value of such items used but not consumed which remains the property of CONTRACTOR.

Sales, use, or similar taxes related to the work, and for which CONTRACTOR is liable, imposed by any governmental authority. Deposits lost for causes other than CONTRACTOR's negligence; royalty payments and fees for permits and licenses. The cost of utilities, fuel and sanitary facilities at the site. Receipted minor expenses such as telegrams, long distance telephone calls, telephone service at the site, expressage and similar petty cash items in connection with the work. Cost of premiums for additional bonds and insurance required because of changes in the work.

C. The term "cost of the work" shall not include any of the following:

C.1 Payroll costs and other compensation of CONTRACTOR's officers, executives, principals (of partnership and sole proprietorships), general managers, engineers, architects, estimators, lawyers, auditors, accountants, purchasing and contracting agents, expeditors, timekeepers, clerks and other personnel employed by

CONTRACTOR whether at the site or in its principal or a branch office for general administration of the work and not specifically included in the agreed-upon schedule of job classifications referred to in this Article, all of which are to be considered administrative costs covered by CONTRACTOR's fee.

- C.2 Expenses of CONTRACTOR's principal and branch offices other than CONTRACTOR's office at the site.
 - C.3 Any part of CONTRACTOR's capital expenses, including interest on CONTRACTOR's capital employed for the work and charges against CONTRACTOR for delinquent payments.
 - C.4 Cost of premiums for all Bonds and for all insurance whether or not CONTRACTOR is required by the Contract Documents to purchase and maintain the same, except for additional bonds and insurance required because of changes in the work.
 - C.5 Costs due to the negligence or neglect of CONTRACTOR, any Subcontractors, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, including but not limited to, the correction of defective work, disposal of materials or equipment wrongly supplied and making good any damage to property.
 - C.6 Other overhead or general expense costs of any kind and the cost of any item not specifically and expressly included in this Section.
- D. CONTRACTOR's fee allowed to CONTRACTOR for overhead and profit shall be determined as follows:
- D.1 A mutually acceptable fixed fee or if none can be agreed upon,
 - D.2 A fee based on the following percentages of the various portions of the cost of the work:
 - For costs incurred under Article 10.4.B.1, CONTRACTOR's fee shall not exceed ten percent (10%);
 - For costs incurred under Article 10.4.B.2, CONTRACTOR's fee shall not exceed ten percent (10%);
 - For costs incurred under Article 10.4.B.3 and B.4, CONTRACTOR's fee shall not exceed seven and one half percent (7.5%); and if a subcontract is on the basis of cost of the work plus a fee, the maximum allowable to the Subcontractor as a fee for overhead and profit shall not exceed ten percent (10%);

No fee shall be payable on the basis of costs itemized under Article 10.4.B.5 and Article 10.4.C.

- E. The amount of credit to be allowed by CONTRACTOR to CITY for any such change which results in a net decrease in cost, will be the amount of the actual net decrease. When both additions and credits are involved in anyone change, the combined overhead and profit shall be figured on the basis of the net increase, if any, however, CONTRACTOR shall not be entitled to claim lost profits for any Work not performed.
- F. Whenever the cost of any work is to be determined pursuant to Articles 10.4.B and 10.4.C, CONTRACTOR will submit in a form acceptable to CONSULTANT an itemized cost breakdown together with the supporting data.
- G. Where the quantity of any item of the Work that is covered by a unit price is increased or decreased by more than twenty percent (20%) from the quantity of such work indicated in the Contract Documents, an appropriate Change Order shall be issued to adjust the unit price, if warranted.
- H. Whenever a change in the Work is to be based on mutual acceptance of a lump sum, whether the amount is an addition, credit or no change-in-cost, CONTRACTOR shall submit an initial cost estimate acceptable to ENGINEER and CITY.
 - H.1 Breakdown shall list the quantities and unit prices for materials, labor, equipment and other items of cost.
 - H.2 Whenever a change involves CONTRACTOR and one or more Subcontractors and the change is an increase in the Contract Price, overhead and profit percentage for CONTRACTOR and each Subcontractor shall be itemized separately.
- I. Each Change Order must state within the body of the Change Order whether it is based upon unit price, negotiated lump sum, or "cost of the work."

10.05 Notification and Claim for Change of Contract Price:

- A. Any claim for a change in the Contract Price shall be made by written notice by CONTRACTOR to the CITY and to ENGINEER within five (5) calendar days of the commencement of the event giving rise to the claim and stating the general nature and cause of the claim. Thereafter, within twenty (20) calendar days of the termination of the event giving rise to the claim, written notice of the extent of the claim with supporting information and documentation shall be provided unless ENGINEER allows an additional period of time to ascertain more accurate data in support of the claim and such notice shall be accompanied by CONTRACTOR's written

notarized statement that the adjustment claimed is the entire adjustment to which the CONTRACTOR has reason to believe it is entitled as a result of the occurrence of said event. All claims for changes in the Contract Price shall be in accordance with Articles 10.3 and 10.4 hereof, if CITY and CONTRACTOR cannot otherwise agree. **IT IS EXPRESSLY AND SPECIFICALLY AGREED THAT ANY AND ALL CLAIMS FOR CHANGES TO THE CONTRACT PRICE SHALL BE WAIVED IF NOT SUBMITTED IN STRICT ACCORDANCE WITH THE REQUIREMENTS OF THIS SECTION.**

10.06 Notice of Change:

If notice of any change affecting the general scope of the work or change in the Contract Price is required by the provisions of any Bond to be given to the Surety, it will be CONTRACTOR's responsibility to so notify the Surety, and the amount of each applicable Bond shall be adjusted accordingly. The CONTRACTOR shall furnish proof of such adjustment to the CITY. Failure of the CONTRACTOR to obtain such approval from the Surety may be a basis for termination of this Contract by the CITY.

10.07 Records:

The CONTRACTOR's representative and the ENGINEER shall compare records of extra work done at the end of the day. Such records shall be made in duplicate upon a form provided for such purpose by the ENGINEER and shall be signed by both the Inspector and the CONTRACTOR's representative, one copy being submitted to the ENGINEER and the other being retained by the CONTRACTOR.

10.08 Canceled Items and Payments Therefore:

The CITY COMMISSION shall have the right to cancel those portions of the Contract relating to the construction of any item provided therein. Such cancellation shall entitle the CONTRACTOR to payment in a fair and equitable amount covering all items of cost incurred by him prior to the date of cancellation or suspension of the work. The CONTRACTOR shall be allowed a profit percentage on the materials used and on construction work actually performed, at the same rates as provided for "Extra Work", but no allowance will be made for anticipated profits. Acceptable materials ordered by the CONTRACTOR or delivered on the work, prior to date of such cancellation or suspension, may be purchased from the CONTRACTOR by the CITY at actual cost and shall thereupon, become property of the CITY, or may be returned to the manufacturer for a reasonable restocking charge.

10.09 Full Payment:

The Compensation herein provided shall be received and accepted by the CONTRACTOR as payment in full for all extra work done or costs incurred in event of cancellation.

ARTICLE 11 - CHANGES IN THE CONTRACT TIME

11.01 Change Order:

The Contract Time may only be changed by a Change Order. A FULLY EXECUTED CHANGE ORDER MUST EXIST PRIOR TO EXTENSION OR SHORTENING OF THE CONTRACT TIME.

11.02 Notification and Claim for Change of Contract Time:

- A. Any claim for a change in the Contract Time shall be made by written notice by the CONTRACTOR to the CITY and to ENGINEER within five (5) calendar days of the commencement of the event giving rise to the claim and stating the general nature and cause of the claim. Thereafter within twenty (20) calendar days of the termination of the event giving rise to the claim, written notice of the extent of the claim with supporting information and documentation shall be provided unless ENGINEER allows an additional period of time to ascertain more accurate data in support of the claim and such notice shall be accompanied by CONTRACTOR's written notarized statement that the adjustment claimed is the entire adjustment to which the CONTRACTOR has reason to believe it is entitled as a result of the occurrence of said event. All claims for changes in the Contract Time shall be determined in accordance with Articles 10.3 and 10.4 hereof, if CITY and CONTRACTOR cannot otherwise agree. **IT IS EXPRESSLY AND SPECIFICALLY AGREED THAT ANY AND ALL CLAIMS FOR CHANGES TO THE CONTRACT TIME SHALL BE WAIVED IF NOT SUBMITTED IN STRICT ACCORDANCE WITH THE REQUIREMENTS OF THIS SECTION.**
- B. The Contract Time will be extended an amount equal to time lost on critical Work items due to delays beyond the control of and through no fault or negligence of CONTRACTOR if a claim is made thereafter as provided in Article 11.2. Such delays shall include, but not be limited to, acts or neglect by any separate contractor employed by CITY, fire, floods, labor disputes, epidemics, abnormal weather conditions or acts of God

11.03 Basis for Extension:

Extensions of time shall be considered and will be based solely upon the effect of delays to the work as a whole. Extensions of time shall not be granted for delays to the work, unless the CONTRACTOR can clearly demonstrate, through

schedule analysis, that the delay to the work as a whole arose in accordance with Article 12.3 or Article 15.1, and that such delays did or will, in fact, delay the progress of work as a whole. Time extensions shall not be allowed for delays to parts of the work that are not on the critical path of the project schedule. Time extensions shall not be granted until all float or contingency time, at the time of the delay, available to absorb specific delays and associated impacts is used.

11.04 Change of Time Due to Contract Execution Problems:

Refer to Article 3.4 for a decrease in Contract Time when the CONTRACTOR fails to return the correctly executed Contract Documents within the time allowed.

11.05 Change of Time Due to Change Order Evaluation:

When evaluating a proposed Change Order, the ENGINEER shall have access to any available float or contingency time. Extension will only be considered in accordance with Article 11.3.

11.06 Change of Time and Inspection and Testing:

Neither observations by the ENGINEER, nor inspections, tests or approvals by others, passing or failing, will be cause for consideration of time extension.

11.07 Change of Time and Defective Work:

- A. If WORK is found to be defective, CONTRACTOR shall bear all remedial expenses including any additional costs experienced by CITY due to delays to others performing additional WORK. CONTRACTOR shall further bear the responsibility for maintaining schedule, and will be excluded from a time extension and the recovery of delay damages due to the uncovering.
- B. If the WORK is found to be defective per the Specifications, but the CITY chooses to accept it at its sole discretion, CONTRACTOR shall bear the responsibility for maintaining schedule, and will be excluded from a time extension and the recovery of delay damages due to the uncovering.

11.08 Liquidated Damages:

All time limits stated in the Contract Documents are of the essence. The provisions of this Article 11 shall not exclude recovery for damages by CITY as indicated in Section 3 of the Supplementary General Conditions.

ARTICLE 12 - WARRANTY AND GUARANTEE; TEST AND INSPECTIONS; CORRECTION, REMOVAL OR ACCEPTANCE OF DEFECTIVE WORK

12.01 Warranty and Guarantee:

The CONTRACTOR warrants and guarantees to the CITY and the ENGINEER that all work will be in accordance with the Contract Documents and will not be defective. Prompt notice of all defects shall be given to the CONTRACTOR. All defective work, whether or not in place, may be rejected, corrected or accepted as provided in this Article.

12.02 Tests and Inspections:

- A. The CONTRACTOR shall give the ENGINEER and, when appropriate, the Building Department and other regulatory authorities which have jurisdiction over the work, timely notice of readiness of the work for all required inspections, tests or approvals.
- B. All inspections performed as a result of the issuance of the Master Building Permit shall be performed by the CITY. All costs associated with such inspections shall be paid by the CITY, EXCEPT THAT should said test or inspection fail to pass the CONTRACTOR shall pay all costs associated with the rework and the retesting.
- C. When any other regulatory authority, by virtue of its rules or regulations, requires specific tests or inspections, the CONTRACTOR shall assume full responsibility for and pay all costs in connection with said tests and inspections.
- D. The CONTRACTOR shall also be responsible for and shall pay all costs in connection with any inspection or testing required in connection with the ENGINEER's acceptance of a manufacturer, fabricator, supplier or distributor of materials or equipment proposed to be incorporated in the work, or of materials or equipment submitted for approval prior to ENGINEER's acceptance thereof for incorporation in the work and as otherwise specified in the Contract Documents.
- E. Neither observations by the ENGINEER nor inspections, tests or approvals by others shall relieve the CONTRACTOR from his obligations to perform the work in accordance with the Contract Documents.

12.03 Uncovering Work:

- A. If any work that is to be inspected, tested or approved is covered without written concurrence of the ENGINEER, it must, if requested, by the ENGINEER, be uncovered. Such uncovering and replacement shall be at the CONTRACTOR's expense.
- B. CONTRACTOR must contact all regulatory agencies issuing construction permits to make all necessary inspections. If CONTRACTOR fails to have the necessary inspections performed and such failure results in uncovering of work already performed, CONTRACTOR shall be responsible for all related time delays and monetary costs.

- C. If the ENGINEER considers it necessary or advisable that work previously covered with his permission or cognizance be observed, inspected or tested, the CONTRACTOR, at the ENGINEER's request, shall uncover, expose or otherwise make available for observation, inspection or testing as the ENGINEER may require, that portion of the work in question, furnishing all necessary labor, material and equipment. If it is found that such work is defective, the CONTRACTOR shall bear all the expenses of such uncovering, exposure, observation, inspection and testing and of satisfactory reconstruction, including compensation for additional professional services. If, however, such work is not found to be defective the CONTRACTOR shall be allowed an increase in the Contract Price or an extension of the Contract Time, or both, directly attributable to such uncovering, exposure, observation, inspection, testing and reconstruction if he makes a claim therefore in accordance with Article 10.2 and Article 11.2.

12.04 City May Stop the Work:

If the work is defective, or the CONTRACTOR fails to supply sufficient skilled workmen or suitable materials or equipment, the CITY may order the CONTRACTOR to stop the work, or any portion thereof, until the cause for such order has been eliminated; however, this right of the CITY to stop the work shall not give rise to any duty on the part of the CITY to exercise this right for the benefit of the CONTRACTOR or any other party.

12.05 Correction or Removal of Defective Work:

If required by the ENGINEER, the CONTRACTOR shall promptly, without cost to the CITY and as specified by the ENGINEER either correct any defective work, whether or not fabricated, installed or completed, or if the work has been rejected by the ENGINEER, remove it from the site and replace it with nondefective work.

12.06 One Year Correction Period:

If within one year after the date of Substantial Completion or Final Completion as applicable, or such longer period of time as may be prescribed by the terms of any applicable special guarantee required by the Contract Documents or by any specific provision of the Contract Documents, any work is found to be defective, the CONTRACTOR shall promptly without cost to the CITY and in accordance with the ENGINEER's written instructions, either correct such defective work, or if it has been rejected by the ENGINEER remove it from the site and replace it with nondefective work. If the CONTRACTOR does not promptly comply with the terms of such instructions, or in an emergency where delay would cause serious risk of loss or damage, the ENGINEER may have the defective work corrected or the rejected work removed and replaced, and all direct and indirect costs of such removal and replacement, including compensation for additional professional services, shall be paid by the CONTRACTOR.

12.07 Acceptance of Defective Work:

If instead of requiring correction or removal and replacement of defective work, the ENGINEER prefers to accept it, he may do so. In such case, if acceptance occurs prior to the ENGINEER's recommendation of final payment, a Change Order shall be issued incorporating the necessary revisions in the Contract Documents, including appropriate reduction in the Contract Price; or if the acceptance occurs after such recommendation, an appropriate amount shall be paid by the CONTRACTOR to the CITY.

12.08 City May Correct Defective Work:

If the CONTRACTOR fails within a reasonable time after written notice of the ENGINEER to proceed to correct and to correct defective work or to remove and replace rejected work as required by the ENGINEER in accordance with Paragraph 12.5, or if the CONTRACTOR fails to perform the work in accordance with the Contract Documents, (including any requirements of the progress schedule), the CITY may, after seven days' written notice to the CONTRACTOR, correct and remedy any such deficiency. In exercising its rights under this Paragraph the CITY shall proceed expeditiously. To the extent necessary to complete corrective and remedial action, the CITY may exclude the CONTRACTOR from all or part of the site, take possession of all or part of the work, and suspend the CONTRACTOR's services related thereto, take possession of the CONTRACTOR's tools, appliances, construction equipment and machinery at the site and incorporate in the work all materials and equipment stored at the site or for which the CITY has paid the CONTRACTOR but which are stored elsewhere. The CONTRACTOR shall allow the CITY, the CITY's representatives, agents and employees such access to the site as may be necessary to enable the CITY to exercise his rights under this Paragraph. All direct and indirect costs of the CITY in exercising such rights shall be charged against the CONTRACTOR in an amount verified by the ENGINEER, and a Change Order shall be issued incorporating the necessary revisions in the Contract Documents and a reduction in the Contract Price. Such direct and indirect costs shall include, in particular but without limitations, compensation for additional professional services required and all costs of repair and replacement of work of others destroyed or damaged by correction, removal or replacement of the CONTRACTOR's defective work. The CONTRACTOR shall not be allowed an extension of the Contract Time because of any delay in performance of the work attributable to the exercise by the CITY of the CITY's rights hereunder.

ARTICLE 13 - PAYMENTS TO THE CONTRACTOR

13.01 Basis of Payment:

Progress payments shall be based on the aggregate of the unit price amounts listed in the Proposal or in the Schedule of Values which have been incorporated in the work acceptable to the ENGINEER.

13.02 Unit Price Inclusion:

The unit prices stated in the Proposal include all costs and expenses for materials, labor, tools, equipment, transportation, commissions, patent fees and royalties, removing crossings or other obstructions, protection or maintaining pipes, drains, railroad tracks, buildings, bridges, or other structures furnishing temporary crossings or bridges, furnishing all supplemental construction stakes, batter boards, templets, common and ordinary labor for handling materials during inspection replacing any property damage, together with any and all costs or expenses for performing and completing the work as specified.

13.03 Schedule of Values: (Lump Sum Price Breakdown)

A Schedule of Values must be submitted within seven days subsequent to the CONTRACTOR executing and submitting the Documents required of Article 15 of the Instructions to Bidders. The schedules shall be satisfactory in form and substance to the ENGINEER, and shall include quantity and unit prices aggregating the Contract Price, and shall subdivide the work into component parts in sufficient detail to serve as the basis for progress payments during construction. Upon acceptance of the schedule of values by the ENGINEER, it shall be incorporated into a form of Application for Payment acceptable to the ENGINEER.

13.04 Changed Conditions: (Unit Price Only)

It is mutually agreed that due to latent field conditions which can not be foreseen at the time of advertising for bids, adjustments of the Plans to field conditions will be necessary during construction; and, therefore, such changes in the plans shall be recognized as constituting a normal and accepted margin of adjustment not unusual and not involving or permitting any change or modification of unit prices, in which case payment will be made for the revised quantities at the unit price bid in the Proposal.

13.05 Application for Progress Payment:

On the 20th day of the month or the first working day thereafter, the CONTRACTOR shall submit to the ENGINEER for review an Application for Payment form filled out and signed by the CONTRACTOR. The form shall be notarized, and shall cover the work completed as of the date of the application. The Application for Payment shall be accompanied by a Schedule of Values, and any other supporting documentation as the ENGINEER may reasonably require.

13.06 Payment for Materials:

If payment is requested on the basis of materials and equipment not incorporated in the work but delivered and suitably stored at the site or at another location agreed to in writing, the Application for Payment shall also be accompanied by such data, satisfactory to the ENGINEER, as will establish the CITY's title to the

material and equipment and protect the CITY's interest therein, including applicable insurance.

13.07 Affidavit Required:

All Applications for Payment shall include an Affidavit of the CONTRACTOR stating that all previous progress payments received on account of the work have been applied to discharge in full all of CONTRACTOR's obligations reflected in prior Applications for Payment. The amount of retainage with respect to progress payments will be 10%.

13.08 Retainage:

The amount of retainage with respect to progress payments will be 10% until 50-percent completion of the construction services purchased pursuant to the Contract. After 50-percent completion of the construction services purchased pursuant to the Contract, the CITY shall reduce to 5 percent the amount of retainage withheld from each subsequent progress payment made to the CONTRACTOR. For purposes of this paragraph, the term "50-percent completion" means the point at which the CITY has expended 50 percent of the total cost of the construction services purchased as identified in the Contract together with all costs associated with existing change orders and other additions or modifications to the construction services provided for in the Contract.

13.09 CONTRACTOR's Warranty of Title:

The CONTRACTOR warrants and guarantees that title to all work, materials and equipment covered by any Application for Payment whether incorporated in the Project or not, will pass to the CITY at the time of payment free and clear of all liens, claims, security interests and encumbrances (hereinafter in these General Conditions referred to as "Liens").

13.10 Review of Application for Payment:

The ENGINEER will, within seven (7) days, review the Application for Payment and either approve and submit it for payment or notify the CONTRACTOR of the deficiencies such that the CONTRACTOR may make the necessary corrections and resubmit in time for the month's payment. However, the ENGINEER may refuse to recommend the whole or any part of any payment if, in his opinion, it would be incorrect to make such representations. He may also refuse to recommend any such payment, or because of subsequently discovered evidence or the results of subsequent inspections or tests, nullify any such payment previously recommended to such extent as may be necessary in the ENGINEER's opinion to protect the CITY from loss because:

- A. The work is defective, or completed work has been damaged requiring correction or replacement.

- B. Written claims have been made against the CITY or Liens have been filed in connection with the work.
- C. The Contract Price has been reduced because of Change Order.
- D. The CITY has been required to correct defective work or complete the work in accordance with Article 12.08.
- E. The CONTRACTOR's unsatisfactory prosecution of the work in accordance with the Contract Documents.
- F. The CONTRACTOR's failure to make payment to Sub- Contractors, or for labor, materials or equipment.

13.11 Payment to the Contractor:

Payments are made only on the fifteenth day or first workday thereafter of each month.

13.12 Projected Cash Flow

Along with the Schedule of Values and the Construction Schedule, the CONTRACTOR must submit for review and acceptance a list of the projected monthly Cash Flows. The cash flows must be in accordance with the construction schedule and must encompass the entire project duration. The contractor must indicate the month and amount expected.

ARTICLE 14 - SUBSTANTIAL COMPLETION, PARTIAL UTILIZATION, FINAL CLEAN UP, INSPECTION, PAYMENT AND ACCEPTANCE

14.01 Substantial Completion:

When the CONTRACTOR considers the entire work ready for its intended use, the CONTRACTOR shall, in writing to the ENGINEER, certify that the entire work is substantially complete and request that the ENGINEER issue a Certificate of Substantial Completion. Within a reasonable time thereafter the CONTRACTOR and the ENGINEER shall make an inspection of the work to determine the status of completion. If the ENGINEER does not consider the work substantially complete, the ENGINEER will notify the CONTRACTOR in writing giving his reasons therefor. If the ENGINEER considers the work substantially complete, the ENGINEER will prepare and deliver to the CONTRACTOR a Certificate of Substantial Completion, which shall fix the date of Substantial Completion. There shall be attached to the certificate a proposed Punch List, developed by the CONTRACTOR, of items to be completed or corrected before final payment.

Within 10 days after delivery of the certificate, the CITY shall review the proposed Punch List and either approve it or contact the CONTRACTOR to

commence good faith efforts to develop a Punch List that is satisfactory to both parties. If the parties are unable to resolve any differences they may have in the development of the Punch List, the ENGINEER shall resolve their differences. The parties shall expedite the process of developing the Punch List with the intent of finalizing the Punch List within 30 days after the date of Substantial Completion.

At the time of delivery of the Certificate of Substantial Completion the ENGINEER will deliver to the CONTRACTOR written notice as to division of responsibilities pending final payment between the CITY and the CONTRACTOR with respect to security, operation, safety, maintenance, heat, utilities and insurance, said responsibilities will be binding on the CITY and the CONTRACTOR until final payment. Unless otherwise stated herein or on the Certificate of Substantial Completion, all building, product, equipment, and machinery warranties will commence on the date of Substantial Completion. The CITY shall have the right to exclude the CONTRACTOR from the work after the date of Substantial Completion, but the CITY shall allow the CONTRACTOR reasonable access to complete or correct items on the Punch List.

14.02 Partial Utilization:

Use by the CITY of any finished part of the work which has specifically been identified in the Contract Documents or which the ENGINEER and the CONTRACTOR agree constitutes a separately functioning and usable part of the work that can be used by the CITY without significant interference with CONTRACTOR's performance of the remainder of the work, may be accomplished prior to Substantial Completion of all the work subject to the following:

- A. The ENGINEER at any time may request the CONTRACTOR in writing to permit the CITY to use any such part of the work which the ENGINEER believes to be ready for its intended use and substantially complete. If the CONTRACTOR agrees, the CONTRACTOR will certify to the ENGINEER that said part of the work is substantially complete and request the ENGINEER to issue a Certificate of Substantial Completion for that part of the work. The CONTRACTOR, at any time, may notify the ENGINEER in writing that the CONTRACTOR considers any such part of the work ready for its intended use and substantially complete and request the ENGINEER to issue a Certificate of Substantial Complete for the part of the work. Within a reasonable time after either such request, the CONTRACTOR and the ENGINEER shall make an inspection of that part of the work to determine its status of completion. If the ENGINEER does not consider that part of the work to be substantially complete, the ENGINEER will notify the CONTRACTOR in writing giving the reasons therefore. If the ENGINEER considers that part of the work to be substantially complete, the provisions of Article 14.01 will apply with respect to Certificate of Substantial Completion of that part of the work

and the division of responsibility in respect thereof and access thereto. It shall be understood by the CONTRACTOR that until such written notification is issued, all responsibility for care and maintenance of all of the WORK shall be borne by the CONTRACTOR. Upon issuance of said written notice of partial utilization, the CITY will accept responsibility for the protection and maintenance of all such items or portions of the WORK described in the written notice.

14.03 Final Clean-Up:

Upon completion of the work and before final inspection shall be made, the CONTRACTOR shall clean and remove from the site, the Right-of-Way and adjacent property, all surplus and discarded materials, rubbish, and temporary structures; restore in an acceptable manner all property, both public and private, which has been damaged during the prosecution of the work; and shall leave the site and vicinity unobstructed in a neat and presentable condition throughout the entire area or length of the work under Contract. The placing of materials of every character, rubbish, or equipment on the abutting property, with or without the consent of the property CITYs, shall not constitute the satisfactory disposal. If the work is of such a character as may be done by block or sections, the CONTRACTOR may be required to promptly remove and dispose of accumulated rubbish, debris or surplus materials from blocks or sections as completed or partially completed. No separate payment will be made for final cleaning up and restoration of property, but all costs thereof shall be included in the prices bid for the various scheduled items of work.

14.04 Final Inspection:

Upon written notice from the CONTRACTOR that the entire work or an agreed portion thereof is complete and final clean-up has been completed, the ENGINEER will make a final inspection with the CONTRACTOR and will notify the CONTRACTOR in writing of all particulars in which this inspection reveals that the work is incomplete or defective. The CONTRACTOR shall immediately take such measures as are necessary to remedy such deficiencies.

14.05 Final Application for Payment:

After the CONTRACTOR has completed all such corrections to the satisfaction of the ENGINEER and delivered all maintenance and operating instructions, schedules, guarantees, Bonds, certificates of inspection, marked-up record documents (as provided in Article 7.19 of the General Conditions and other documents; all as required by the Contract Documents and after the ENGINEER has indicated that the work is acceptable (subject to the provisions of Article 14.9) the CONTRACTOR may make Application for Final Payment following the procedure for progress payments. The final Application for Payment shall be accompanied by all documentation called for in the Contract Documents, together with complete and legally effective releases or waivers (satisfactory to

the CITY) of all Liens arising out of or filed in connection with the work. In lieu thereof and as approved by the CITY, the CONTRACTOR may furnish receipts or releases in full; an affidavit of the CONTRACTOR that the releases and receipts include all labor, services, material and equipment for which a Lien could be filed, and that all payrolls, material and equipment bills, and other indebtedness connected with the work for which the CITY or the CITY's property might in any way be responsible, have been paid or otherwise satisfied; and consent of the Surety, if any, to final payment. If any Subcontractor or Supplier fails to furnish a release or receipt in full, the CONTRACTOR may furnish a Bond or other collateral satisfactory to the CITY to indemnify the CITY against any Lien.

14.06 Final Payment and Acceptance:

If on the basis of the ENGINEER's observation of the work during construction and final inspection, and the ENGINEER's review of the final Application for Payment and accompanying documentation, all as required by the Contract Documents, the ENGINEER is satisfied that the work has been completed and the CONTRACTOR's other obligations under the Contract Documents have been fulfilled, the ENGINEER will recommend payment. Thereupon the ENGINEER will give written notice to the CITY and the CONTRACTOR that the work is acceptable subject to the provisions of Article 14.9.

14.07 Payment of Retainage Without Final Completion:

If through no fault of the CONTRACTOR, final completion of the work is significantly delayed and if the ENGINEER so confirms, the CITY shall, upon receipt of the CONTRACTOR's final Application for Payment and recommendation of the ENGINEER, and without terminating the Agreement, make payment of the balance due for the portion of the work fully completed and accepted. If the remaining balance to be held by the CITY for work not fully completed or corrected is less than the retainage stipulated in the Agreement and if Bonds have been furnished as required in Article 5.2, the written consent of the Surety to the payment of the balance due for that portion of the work fully completed and accepted shall be submitted by the CONTRACTOR to the ENGINEER with the application for such payment. Such payment shall be made under the terms and conditions governing final payment, except that it shall not constitute a waiver of claims.

14.08 CONTRACTOR's Continuing Obligation:

The CONTRACTOR's obligation to perform and complete the work in accordance with the Contract Documents shall be absolute. Neither recommendation of any progress or final payment by the ENGINEER, nor the issuance of a Certificate of Substantial Completion, nor any payment by the CITY to the CONTRACTOR under the Contract Documents, nor any use or occupancy of the work or any part thereof by the CITY nor any act of acceptance by the CITY nor any failure to do

so, nor any review and approval of a Shop Drawing or sample submission, nor the issuance of a notice of acceptability by the ENGINEER pursuant to Article 14.6, nor any correction of defective work by the CITY will constitute an acceptance of work not in accordance with the Contract Documents or a release of the CONTRACTOR's obligation to perform the work in accordance with the Contract Documents (except as provided in Article 14.9).

14.09 Waiver of Claims:

The making and acceptance of final payment will constitute:

- A. A waiver of all claims by the CITY against the CONTRACTOR, except claims arising from unsettled Liens, from defective work appearing after final inspection pursuant to Article 14.04 or from failure to comply with the Contract Documents or the terms of any special guarantees specified therein; however, it will not constitute a waiver by the CITY of any rights in respect of the CONTRACTOR's continuing obligations under the Contract Documents.
- B. A waiver of all claims by the CONTRACTOR against the CITY other than those previously made in writing and still unsettled.

ARTICLE 15 - SUSPENSION OF WORK AND TERMINATION

15.01 City May Suspend Work:

The CITY may, at any time and without cause, suspend the work or any portion thereof for a period of not more than 90 days by notice in writing to the CONTRACTOR which will fix the date on which work will be resumed. The CONTRACTOR shall resume the work on the date so fixed. The CONTRACTOR shall be allowed an increase in the Contract Price or an extension of the Contract Time, or both, directly attributable to any suspension.

15.02 City May Terminate:

- A. Upon the occurrence of any one or more of the following events:
 - 1. If the CONTRACTOR commences a voluntary case under any chapter of the Bankruptcy Code (Title 11, United States Code), as now or hereafter in effect, or if the CONTRACTOR takes any equivalent or similar action by filing a petition or otherwise under any other federal or state law in effect at such time relating to the bankruptcy or insolvency.
 - 2. If a petition is filed against the CONTRACTOR under any chapter of the Bankruptcy Code as now or hereafter in effect at the time of filing, or if a petition is filed seeking any such equivalent or similar relief against the CONTRACTOR under any other federal or state law in

effect at the time relating to bankruptcy or insolvency.

3. If the CONTRACTOR makes a general assignment for the benefit of creditors.
 4. If a trustee, receiver, custodian or agent of the CONTRACTOR is appointed under applicable law or under contract, whose appointment or authority to take charge of property of the CONTRACTOR is for the purpose of enforcing a Lien against such property or for the purpose of general administration of such property for the benefit of the CONTRACTOR's creditors.
 5. If the CONTRACTOR admits in writing an inability to pay its debts generally as they become due.
 6. If the CONTRACTOR persistently fails to perform the work in accordance with the Contract Documents (including, but not limited to, failure to supply a qualified superintendent or sufficient skilled workers or suitable materials or equipment or failure to adhere to the approved progress schedule revised from time to time).
 7. If the CONTRACTOR disregards laws or regulations of any public body having jurisdiction.
 8. If the CONTRACTOR disregards the authority of the ENGINEER.
 9. If the CONTRACTOR otherwise violates in any substantial way any provisions of the Contract Documents.
- B. The CITY may, after giving the CONTRACTOR and the Surety seven days' written notice and to the extent permitted by laws and regulations, terminate the services of the CONTRACTOR, exclude the CONTRACTOR from the site and take possession of the work and of all the CONTRACTOR's tools, appliances, construction equipment and machinery at the site and use the same to the full extent they could be used by the CONTRACTOR (without liability to the CONTRACTOR for trespass or conversion), incorporate in the work all materials and equipment stored at the site or for which the CITY has paid the CONTRACTOR but which are stored elsewhere, and finish the work as the CITY may deem expedient. In such case the CONTRACTOR shall not be entitled to receive any further payment until the work is finished. If the unpaid balance of the Contract Price exceeds the direct, indirect and consequential costs of completing the work (including but not limited to fees and charges of engineers, architects, attorneys and other professionals, and court and arbitration costs) such excess will be paid to the CONTRACTOR. If such costs exceed such unpaid balance, the CONTRACTOR, or CONTRACTOR's Surety, shall pay the difference to the CITY.

- C. Where the CONTRACTOR's services have been so terminated by the CITY, the CITY alone shall determine the scope and description of the work to be completed and the method and schedule for completing it.
- D. Where the CONTRACTOR's services have been so terminated by the CITY the termination will not affect any rights or remedies of the CITY against the CONTRACTOR then existing or which may thereafter accrue. Any retention or payment of moneys due the CONTRACTOR by the CITY will not release the CONTRACTOR from liability.
- E. Upon seven days' written notice to the CONTRACTOR the CITY may, without cause and without prejudice to any other right or remedy, elect to abandon the work and terminate the Contract. In such case the CONTRACTOR shall be paid for all work executed and any expense sustained plus reasonable termination expenses, which will include, but not be limited to, direct, indirect and consequential costs (including, but not limited to, fees and charges of engineers, architects, attorneys and other professionals and court and arbitration costs).

15.03 Contractor May Stop Work or Terminate:

If through no act or fault of the CONTRACTOR, the work is suspended for a period of more than 90 days by the CITY or under an order of court or other public authority, or the CITY fails for 60 days to pay the CONTRACTOR any sum finally determined to be due, then the CONTRACTOR may, upon seven days' written notice to the CITY terminate the Contract and recover from the CITY payment for all work executed and any expense sustained plus reasonable termination expenses. In addition and in lieu of terminating the Contract, if the CITY has failed to make any payment as aforesaid, the CONTRACTOR may upon seven days' written notice to the CITY stop the work until payment of all amounts then due are paid. The provisions of this paragraph shall not relieve the CONTRACTOR of the obligations to carry on the work in accordance with the progress schedule and without delay during disputes and disagreements with the CITY.

ARTICLE 16 - DISPUTE RESOLUTION

16.01 Methods and Procedures

- A. Dispute resolution methods and procedures, if any, shall be as set forth in the Supplementary Conditions. If no method and procedure has been set forth, and subject to the provisions of Paragraph 10.05, City and Contractor may exercise such rights or remedies as either may otherwise have under the Contract Documents or by Laws or Regulations in respect of any dispute.

- END OF SECTION -

SECTION 00800
SUPPLEMENTARY GENERAL CONDITIONS
INDEX TO ARTICLES

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General Note:

The General Conditions refer to specific section numbers in the Supplementary General Conditions. These reference numbers may not coordinate with the actual Article numbers utilized in the Supplementary General Conditions. The CONTRACTOR shall comply with all General Conditions and all Supplementary General Conditions as well as related conditions included in the General Requirements, Division 1 of the Technical Specifications. Incorrect cross-reference numbers shall not relieve this requirement.

1. Project Schedule

Time is of the essence for this work. The following defines the schedule for the project:

CONSTRUCTION WORK SCHEDULE CONSTRUCTION / STARTUP / ACCEPTANCE:	
<u>Major Milestones</u>	<u>Completion Time (calendar days)</u>
1. Oxygenation Train Nos. 1 & 2 Deck Rehabilitation	280
2. Substantial Completion	630
3. Project Closeout	660

Failure to meet any of the above defined construction/startup/acceptance completion dates shall subject the CONTRACTOR to pay damages as specified in these Supplementary General Conditions in Article 3. Completion time refers to the number of calendar days after the date of the Notice to Proceed.

Substantial Completion

1. Refer to General Conditions Articles 14.1 and 14.2. (Certification of Substantial Completion Services appended to the Supplementary General Conditions).
2. Substantial Completion shall also include:
 - Completion of all punch list items. "Completion of punch list items" shall be as determined by the Engineer in the field.
 - The complete piping and pumping system shall be tested and demonstrated for the Engineer's acceptance. Please refer to the Specification Division 11 Equipment and Division 15 Mechanical for the testing requirements. The Engineer shall determine testing and demonstration sufficient for acceptance.
 - Complete structural rehabilitation of RAS Pump Station No. 1, including receipt of all approvals.
 - Complete structural rehabilitation of Oxygenation Trains 1 and 2, including receipt of all approvals.

- Coating touchup completed and accepted by Engineer.
- Record shop drawings and O&M submittals received and accepted by the Engineer.
- Record drawing red-lines received and accepted by the Engineer.
- Delivery and acceptance by the Engineer of all spare parts and special tools.
- Guarantee certifications, performance affidavits, and all other certifications received and accepted by the Engineer.

Contractor shall also conform to construction sequence constraints as defined on the Drawings and in Specifications.

Project Closeout

1. Refer to Division 1 General Requirements, Section 01700 Project Closeout.
2. Project Closeout shall also include:
 - All requirements of substantial completion met plus the following
 - Site cleanup and restoration completed
 - Minor punch list items completed (minor as defined by the Engineer in the field)
 - Demobilization completed
 - Releases from all parties who are entitled to claims

The title "Engineer" utilized in these descriptions for substantial and final completion shall mean the City staff engineer assigned to this project, or his designated representative.

2. **Insurance Requirements**

The insurance required by Article 5.6 of the General Conditions shall be as follows:

A. GENERAL LIABILITY (GL3)

Prior to the commencement of work governed by this contract, the Contractor shall obtain General Liability Insurance. Coverage shall be maintained throughout the life of the contract and include, as a minimum:

- Premises Operations
- Products and Completed Operations
- Blanket Contractual Liability
- Personal Injury Liability
- Expanded Definition of Property Damage

The minimum limits acceptable shall be:

\$1,000,000 Combined Single Limit (CSL)

If split limits are provided, the minimum limits acceptable shall be:

\$1,000,000 per Person
\$1,000,000 per Occurrence
\$100,000 Property Damage

An Occurrence Form policy is preferred. If coverage is provided on a Claims Made policy, its provisions should include coverage for claims filed on or after the effective date of this contract. In addition, the period for which claims may be reported should extend for a minimum of twelve (12) months following the acceptance of work by the City.

The City of Hollywood and Hazen and Sawyer shall be named as Additional Insured on all policies issued to satisfy the above requirements.

B. VEHICLE LIABILITY (VL2):

Recognizing that the work governed by this contract requires the use of vehicles, the Contractor, prior to the commencement of work, shall obtain Vehicle Liability Insurance. Coverage shall be maintained throughout the life of the contract and include, as a minimum, liability coverage for:

➤ Owned, Non-Owned, and Hired Vehicles

The minimum limits acceptable shall be:

\$500,000 Combined Single Limit (CSL)

If split limits are provided, the minimum limits acceptable shall be:

\$100,000 per Person
\$500,000 per Occurrence
\$50,000 Property Damage

The City of Hollywood and Hazen and Sawyer shall be named as Additional Insured on all policies issued to satisfy the above requirements.

C. WORKERS' COMPENSATION (WC3):

Prior to the commencement of work governed by this contract, the Contractor shall obtain Workers' Compensation Insurance with limits sufficient to respond to the applicable state statutes.

In addition, the Contractor shall obtain Employers' Liability Insurance with limits of not less than:

\$1,000,000 Bodily Injury by Accident
\$1,000,000 Bodily Injury by Disease, policy limits
\$1,000,000 Bodily Injury by Disease, each employee

Coverage shall be maintained throughout the entire term of the contract.

Coverage shall be provided by a company or companies authorized to transact business in the state of Florida and the company or companies must maintain a minimum rating of A-VI, as assigned by the A.M. Best Company.

If the Contractor has been approved by the Florida's Department of Labor, as an authorized self-insurer, the City shall recognize and honor the Contractor's status. The Contractor may be required to submit a Letter of Authorization issued by the Department of Labor and a Certificate of Insurance, providing details on the Contractor's Excess Insurance Program.

If the Contractor participates in a self-insurance fund, a Certificate of Insurance will be required. In addition, the Contractor may be required to submit updated financial statements from the fund upon request from the City.

The policy(s) must be endorsed to provide the City with thirty (30) days notice of cancellation and/or restriction.

If applicable, any sub-contractor(s) used by the Contractor shall supply such similar insurance required of the Contractor. Such certificates shall name the City as additional insured.

3. Liquidated Damages

Liquidated damages shall be paid by the CONTRACTOR to the CITY for failure to complete work on time in accordance with the following schedule:

CONSTRUCTION/STARTUP/ACCEPTANCE:		
<u>Major Milestones</u>	<u>Completion Time (calendar days)</u>	<u>Liquidated Damages</u>
1. Oxygenation Train Nos. 1 & 2 Deck Rehabilitation	280	\$1,000/day
2. Substantial Completion	630	\$1,000/day
3. Project Closeout	660	\$1,000/day

The CITY is hereby authorized to deduct the sums described above from the monies which may be due to the CONTRACTOR for the work under this contract. Liquidated damages shall be additive such that the maximum total which may be deducted shall be \$3,000/day. Other damages for failure to meet warranty conditions as defined in other sections of the Specifications shall also be added with liquidated damages for failure to meet completion times. Completion time refers to the number of calendar days after the date of the Notice to Proceed.

4. Restricted Area

The CONTRACTOR shall, in installing the new facilities, confine all activities within the CITY property, easement, and right-of-ways indicated.

5. Existing Facilities and Structures

All existing facilities shall be protected, and if damaged, shall be repaired by the CONTRACTOR at no additional cost to the CITY.

6. Explosives

Explosives shall not be used on this project.

7. Contract Documents

The CITY will provide the CONTRACTOR with one (1) set of executed Contract Documents after the Notice to Proceed.

8. Required Notifications

When provisions of the pertinent codes, standards or regulations conflict with this Specification, the more stringent shall apply.

Prior to any site work, the CONTRACTOR shall notify the Engineering and Construction Services Division Inspector at (954) 921-3930.

Prior to excavation at the site, the CONTRACTOR shall notify the appropriate utilities and Sunshine State One-Call of Florida, Inc. (formerly U.N.C.L.E.) at 1-800-432-4770 for locations of buried utilities.

Prior to closure of any CITY streets or alleyways, or other activity which requires the diversion of traffic, the CONTRACTOR shall notify and obtain the permission of the CITY of Hollywood Fire and Police Communications Section at (954) 967-4321.

9. Notice of Completion

See attached form.

10. Prevailing Wage Requirement (Not Used)

11. Inspections and Testing During Overtime

A. The following supplement Article 3.15 and 3.16 of the General Conditions:

For weekend work, CONTRACTOR shall submit a written request to the CITY by the preceding Wednesday. A separate request is required for each week that the CONTRACTOR wished to work on a weekend. For evening and holiday work, CONTRACTOR shall submit a written request to the CITY three (3) days in

advance. The CITY will provide inspection services for all overtime work and the CONTRACTOR shall pay for inspection services per Article 3.15, no exceptions.

Similarly, holiday and other overtime work shall be requested a minimum of 36-hours in advance and CITY will provide inspection for all overtime.

- B. Exceptions to the hours and days of the week for work and other related limitations are allowed only for tie-ins during low flow periods / early morning hours, coatings that need to be applied during lower temperature times of the day and whenever the Documents specifically define that work shall be completed outside of the limitations for "normal" work hours, days, etc.

Inspection for tie-ins during low flow/early morning and specialty coating application performed during nighttime will not be cause for extra inspection costs unless such work is remedial in nature as a result of defective work.

12. Retainage

After 50-percent completion of the construction services purchased pursuant to this contract, CONTRACTOR may present to CITY a payment request for one-half of the retainage then held by CITY. CITY shall promptly make payment to CONTRACTOR, unless CITY has grounds for withholding the payment of retainage. CITY shall have grounds for withholding the payment of retainage with respect to any amounts that are the subject of a good-faith dispute, the subject of a claim brought pursuant to Florida Statute Section 255.05, or otherwise the subject of a claim or demand by CITY or CONTRACTOR.

At acceptance of Substantial Completion, CITY shall promptly make payment to CONTRACTOR of one-half of the retainage then held by CITY. At acceptance of completion of all punch list items, CITY shall promptly make payment to CONTRACTOR the balance of retainage then held by CITY.

13. Purchase Order Terms and Conditions

The following Terms and Conditions are applicable to this order entered into by and between the City of Hollywood (referred to as Buyer) and Vendor (referred to as Seller).

A. MODIFICATIONS

This purchase order form, and any other document pertaining to this transaction which has been acknowledged in writing by the Director is a complete and exclusive statement of this order. Accordingly no modification or amendment shall be binding upon the Buyer unless signed by the Director. The City Attorney has approved these standard terms and conditions as to form and legality. Accordingly no modification of these terms and conditions shall be binding upon buyer unless they are endorsed and approved by the City Attorney. In the event of a conflict between these terms and conditions and any other document pertaining to the transaction covered by this order, these terms and conditions shall prevail.

B. ASSIGNMENT

Any assignment of this order or the performance of work hereunder, in whole or in part, is prohibited.

C. EXCUSABLE DELAYS

The Buyer may grant additional time for any delay or failure to perform hereunder if the delay will not adversely impact the best interests of the Buyer and is due to causes beyond the control of to Seller. Such grant must be in writing and made part of the order.

D. DEFAULT

In the event of default by the Seller, Buyer may procure the articles or services covered by this order from other sources and hold to Seller responsible for any excess costs occasioned thereby, in addition to all other available remedies at law or equity.

E. TERMINATION

Buyer, acting through its City Manager or his/her designee, reserves the right to terminate this order In whole or in part for default (a) if Seller fails to perform In accordance with any of the requirements of this order or (b) If Seller becomes insolvent or suspends any of its operations or if any petition is filed or proceeding commenced by or against Seller under any State or Federal Law relating to bankruptcy, reorganization, receivership or assignment for the benefit of creditors. Any such termination will be without liability to Buyer except for completed Items delivered and accepted by the Buyer. Seller, will be liable for excess costs of reprocurement.

F. F.O.B.

In those cases where F O.B. point is not Destination, Seller is required to prepay freight charges and list separately on invoice. Collect shipments will not be accepted

G. TERMS

By accepting this order, the Seller agrees that payment terms shall be Net 30 unless otherwise stated.

H. INVOICING

Seller must render original invoice to the City of Hollywood, Department of Financial Services, P.O. Box 229045, Hollywood, Florida 33022-9045.

I. TAX

The City of Hollywood is exempt from Federal and State taxes for tangible personal property. Sellers doing business with the City, which are not otherwise exempt, shall not be exempt from paying sales tax to their suppliers for materials to fulfill contractual obligations with the City, nor shall any Seller be authorized to use the City Tax Exemption Number in securing such materials

- J. **RESPONSIBILITY**
Responsibility will not be accepted for any goods delivered or services performed unless covered by a duly signed and authorized City of Hollywood order, issued by the Procurement Services Division.
- K. **ACCEPTANCE**
Sellers acceptance of this order will be presumed unless Seller acknowledges exception, in writing, to Buyer within ten (10) calendar days after date of order.
- L. **DELIVERIES**
Deliveries are to be made during the hours of 7:30 a.m. to 4:00 p.m. Monday through Friday, excluding holidays, unless otherwise stipulated. Seller shall notify the Buyer of deliveries that require special handling and/or assistance for off-loading. Failure to notify the Buyer concerning this type of delivery will result in the billing to Seller of any add-on redelivery, storage or handling charges.
- M. **INSPECTION**
All Commodities delivered on this order are subject to inspection upon receipt by a representative of the Buyer. All rejected commodities shall remain the property of the Seller and will be returned at the Seller's expense.
- N. **QUANTITIES**
Quantities specified in the order cannot be changed without Buyer approval. Goods shipped in excess of quantity designated may be returned at the Seller's expense.
- O. **PAYMENT CHANGES**
Payments will be made only to the company and address as set forth on order unless the Seller has requested a change thereto on official company letterhead, signed by an authorized officer of the company.
- P. **ANTI-DISCRIMINATION**
Sellers doing business with the Buyer are prohibited from discriminating against any employee, applicant or client because of race, creed, color, national origin, sex or age with regard to but not limited to the following: employment practices, rates of pay or other compensations, methods and training selection.
- Q. **UNIFORM COMMERCIAL CODE**
Florida law, including without limitation the Uniform Commercial Code (Chapter 670 – 680, Florida Statutes), shall apply to and supplement the terms and conditions of this order. Venue shall lie in a court of competent jurisdiction in Broward County, Florida.
- R. **LEGAL RESPONSIBILITY**
By accepting this order, Seller understands and agrees that the items covered herein, or services to be rendered, shall be manufactured, sold or performed in compliance with applicable Federal, State, County and Local laws, ordinances, rules and regulations. Lack of knowledge by the Seller shall in no way be a cause for relief from responsibility.

- S. **LIABILITY - COPYRIGHT/PATENT/TRADEMARK**
Seller shall save and hold harmless Buyer, its officers, employees and agents from liability for infringement of any United States patent, trademark or copyright for or on account of the use of any product sold to Buyer or used in the performance of this order.
- T. **INDEMNIFICATION**
Seller shall indemnify, hold harmless and defend Buyer, its officers, employees and agents from and against any and all claims, damages, liability, judgments or causes of action, including costs, expenses and attorney fees, incurred as a result of any error, omission or negligent act by the Seller, its officers, employees, agents, subcontractors or assignees arising out of this order.
- U. **OCCUPATIONAL SAFETY AND HEALTH**
Seller must comply with requirements under Chapter 442, Florida Statutes, that any toxic substance delivered as a part of this order must be accompanied by a Materials Safety Data Sheet (M.S.D.S.).
- V. **REPRESENTATIVE**
All parties to this order agree that the representatives named herein are, in fact, bonafide and possess full and complete authority to bind said parties.
- W. **PUBLICITY**
No endorsement by the City of the product and/or service will be used by Seller in any way, manner or form in product literature or advertising.
- X. **INSURANCE**
The Seller of services must have secured and maintained the required amount of \$1,000,000 general and \$500,000 automobile liability limits and must list the City and Hazen and Sawyer as an additional insured of this coverage. The Seller must have worker's compensation coverage as required by law. Any exception to the above stated limits or other requirements must be endorsed and approved by the City of Hollywood Risk Manager.

CERTIFICATE OF SUBSTANTIAL COMPLETION

PROJECT: RAS PUMP STATION NO. 1 REPLACEMENT

ENGINEER: Engineering and Construction Services Division

TO:

CONTRACTOR:

CONTRACT FOR:

NOTICE TO PROCEED DATE:

DATE OF ISSUANCE:

PROJECT OR DESIGNATED PORTION SHALL INCLUDE:

Portions of the work performed under this Contract as described above, have been reviewed and found to be substantially complete. The Date of Substantial Completion of Project or designated portion thereof designated above is hereby established as _____ which is also the date of commencement of applicable warranties required by the Contract Documents for the noted area.

DEFINITION OF DATE OF SUBSTANTIAL COMPLETION

The Date of Substantial Completion of the work or designated portion thereof is the date certified by the ENGINEER ("Date of Issuance" above) when construction is sufficiently complete, in accordance with the Contract Documents, so the CITY can occupy or utilize the work or designated portion thereof for the use for which it is intended, as expressed in the Contract Documents.

A list of items to be completed or corrected, prepared by the CONTRACTOR and verified and amended by the ENGINEER, for the above referenced "Project or Designated Portion" is attached to this form (attached "Punch List" dated _____).

The failure to include any items on such list does not alter the responsibility of the CONTRACTOR to complete all work in accordance with the Contract Documents.

CERTIFICATE OF SUBSTANTIAL COMPLETION

Please note that in accordance with Article 14 General Conditions, the Contractor retains full responsibility for the satisfactory completion of all work regardless of whether the Owner occupies and / or operates a part of the facility and that the taking possession and use of such work shall not be deemed an acceptance of any work not completed in accordance with the Contract Documents.

ENGINEER	BY	DATE
-----------------	-----------	-------------

CONTRACTOR	BY	DATE
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The CITY OF HOLLYWOOD, through the City's authorized representative, accepts the work or designated portion thereof as substantially complete and will assume full possession thereof at _____(time) on _____(date).

BY	DATE
-----------	-------------

- END OF SECTION -

SECTION 00900

ADDENDA

(Addenda are attached.)



**CITY OF HOLLYWOOD
DEPARTMENT OF PUBLIC UTILITIES
ENGINEERING & CONSTRUCTION SERVICES DIVISION**

1621 N. 14th Avenue
Hollywood, FL 33019
Phone (954) 921-3930 Fax (954) 921-3591

ADDENDUM NUMBER 1

Date: **November 11, 2019**

FOR: **Southern Regional Wastewater Treatment Plant
RAS Pump Station No. 1 Replacement**

FILE NUMBER: **17-9523**

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 dated September 2019. 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: GENERAL

A. Section 00030 – Notice To Bidders

The Bid Submittal and Opening date has been postponed from November 12, 2019 to **November 14, 2019**. The time and location for bid delivery and opening remain the same.

B. Pre-Bid Meeting

The Pre-bid Meeting Agenda, Minutes, and Attendance Record for the Pre-Bid Meeting dated October 22, 2019 are attached.

Item 2: BIDDING PACKAGE and SPECIFICATIONS

A. Section 00030 – Notice To Bidders

1. The Bid Submittal and Opening date has been postponed from November 12, 2019 to **November 14, 2019**. The time and location for bid delivery and opening remain the same.



**CITY OF HOLLYWOOD
DEPARTMENT OF PUBLIC UTILITIES
ENGINEERING & CONSTRUCTION SERVICES DIVISION**

1621 N. 14th Avenue
Hollywood, FL 33019
Phone (954) 921-3930 Fax (954) 921-3591

ADDENDUM NUMBER 1

B. Section 15100 – Valve Operators and Electric Valve Actuators

1. In Paragraph 2.03(A)(1), remove “, or equal by Rotork”.
2. In Paragraph 2.03(A)(2), remove “, or equal by Rotork”.

C. Section 15390 – Piping Schedule

1. In Paragraph 1.04 Piping Schedule, replace “CL 53” under Thickness Class or Schedule with “Note 1” for both RAS Piping Below Ground and Clarifier Drain Piping.

Item 3: DRAWINGS

A. Drawing A-1

1. On Drawing A-1, replace “GB 580-50” with “GB-480-50” for the new roof exhaust fan.

B. Drawing E-6

1. Replace existing Drawing E-6 with attached Addendum 1 Drawing E-6.

Item 4: RESPONSE TO QUESTIONS

Question 1 Please provide the engineer’s estimate for the referenced project.

Response: The Engineer’s Opinion of Probable Construction Cost for the RAS Pump Station No. 1 Replacement project is \$3.6 Million.

Question 2 Limits of the work for Alternate Bid Item A-1 are shown on sheet C-1. Can the limits of Alternate Bid Item A-1 work also be shown on sheet M-1?

Response: Alternate Bid Item A-1 is described in the Contract Documents and may be performed in lieu of replacement of the RAS Pump Station wall pipe and exterior stairwell, etc. Piping interior to pump station building shall be replaced in kind.



**CITY OF HOLLYWOOD
DEPARTMENT OF PUBLIC UTILITIES
ENGINEERING & CONSTRUCTION SERVICES DIVISION**

1621 N. 14th Avenue
Hollywood, FL 33019
Phone (954) 921-3930 Fax (954) 921-3591

ADDENDUM NUMBER 1

Question 3 *Please confirm exterior handrail on S-3 and S-4 is aluminum and interior handrail is FRP.*

Response: Handrail exterior to RAS PS No. 1 shall be aluminum per details. Interior handrail shall be FRP per details.

Question 4 *Dwg A-1 calls for a GB-580 exhaust fan. The largest model GB fan is a 540. Please advise. Please provide a spec for the fan, if possible?*

Response: The new roof exhaust fan shall be revised to Greenheck, Model GB-480-50 on Drawing A-1.

Question 5 *Building permits required?*

Response: As the project work is rehabilitation/repair work, the City stated they do not expect any building department permitting. However, there is an allowance account for permits/licenses.

Question 6 *Allowable working hours?*

Response: Normal Contractor work hours at the Southern Regional WWTP are 7am to 5pm, Monday through Friday. Night or weekend work outside of these hours may be subject to overtime work for City inspectors, and the Contractor shall bear the cost of overtime City inspection.

Question 7 *Is there a precondition engineer report on all the structures? There are apparent leaks at the RAS #1 building walls, will the owner or contractors responsible for those?*

Response: Please refer to the Contract Documents.

Question 8 *Confirm project durations and required milestones, in the pre-bid meeting was mentioned 280 days but the advertisement shows 630 day to substantial.*

Response: Please refer to the Contract Documents.

Question 9 *Will the owner pay for testing, please confirm.*

Response: Please refer to the Contract Documents.



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ADDENDUM NUMBER 1

Question 10 Salvage equipment requirements and storage, will the owner take position of the salvage equipment after des-installation or contractor will have to store material for a certain period of time? Will the turn over of the salvage equipment within the plant or in outside warehouse or facility?

Response: Items to be salvaged shall be stockpiled on the site, in a location as designated by the City.

Question 11 What/where is the location of the onsite waste water basin for the waste water dewatering as noted in the specifications 01520-1.06G.

Response: The City stated during the Pre-Bid meeting that there is a nearby manhole that may be used for disposal of wastewater drained from the existing Clarifier structure and drain piping. A Request of Services (RFS) must be submitted to the City in advance of services, per the Contract Documents.

Question 12 Are there testing requirements for the leak repairs on the Oxygenation Trains/epoxy repair, not clear in contract documents.

Response: The project work at Oxygenation Trains 1 and 2 is outlined in the Contract Documents.

Question 13 On the drawing pictures, there is a lot of broken sidewalk on the work area. Is the contractor responsible to restore these?

Response: In areas of the proposed work, or areas damaged due to construction during the project, the Contractor is responsible for complete restoration of the site to existing or better condition, per the Contract Documents. Refer to Division 2 of the Contract Documents and the Drawings for sitework requirements. Sidewalks undisturbed during the project are not required to be replaced.

Question 14 CIPP alternate cost is not clear in the drawings. Please advise the pipe length on the 16" and locations that required CIPP.

Response: The diameter and section of pipe to be lined is indicated in the Drawings.



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ADDENDUM NUMBER 1

Question 15 *Line stops and plugs are not within the bid items to isolate discharge pipe. Please advise.*

Response: Discharge line shall be taken out of service when discharge valves are replaced during the two-week period when Clarifier Nos. 1 & 2 are out of service, as outlined in Section 01520. Contractor shall coordinate with City for isolation valves.

Question 16 *For consideration on Section 09900 subsection 1.04 Manufacturers, will Epoxytec International be included as an approved painting manufacturer? For consideration on Sections 03732 Concrete Repairs, will Epoxytec CPP series, including CPP Gel Crack Injection, be included and/or approved as a repair method for concrete cracks with a 100% solids epoxy repair material. City of Hollywood and Epoxytec International have had a long, successful partnership on collections and treatment facilities. With recent Wet well specifications calling for Epoxytec lining systems and specialized City of Hollywood facilities projects, Our systems have been proven in the harshest environments. Our submission would detail our Structural Epoxy lining system in spray application for cost effectiveness.*

Response: Per Section 09900, Paragraph 1.05, all painting materials shall be as manufactured by Tnemec, Carboline, Ameron, PPG, or Sherwin Williams, unless otherwise stated in the Contract Documents. In reference to Section 03732, alternate products will be evaluated as an "or equal" in accordance with the Contract Documents where "or equal" is specified.

Question 17 *Ductile Spec 15006 Requires Buried DIP to be PC350. Piping Schedule in 15390 Table 1.04 calls for CL53 on Below Ground DIP. Please confirm CL350 can be used for Buried DIP on this project. D18.*

Response: See Addendum Item 2 above.

Question 18 *15006 2.01 A calls for domestic pipe & fittings per City of Hollywood. Are there any federal funds associated with this project or is that a City of Hollywood preference? Also are there any other products that they require to be domestic? (MJ Restraints, etc?)*

Response: Domestic manufacturer requirements are City of Hollywood policy. Refer to Section 15000 – Basic Mechanical Requirements.



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ADDENDUM NUMBER 1

Question 19 Is the project sole sourced on Plug Valves or will an equal be allowed?

Response: Plug valves shall be manufactured by DeZurik Company, per the requirements of Section 15109 – Plug Valves.

Question 20 Will you review equals to the Electric Actuator spec?

Response: See Addendum Item 2 above.



**CITY OF HOLLYWOOD
DEPARTMENT OF PUBLIC UTILITIES
ENGINEERING & CONSTRUCTION SERVICES DIVISION**

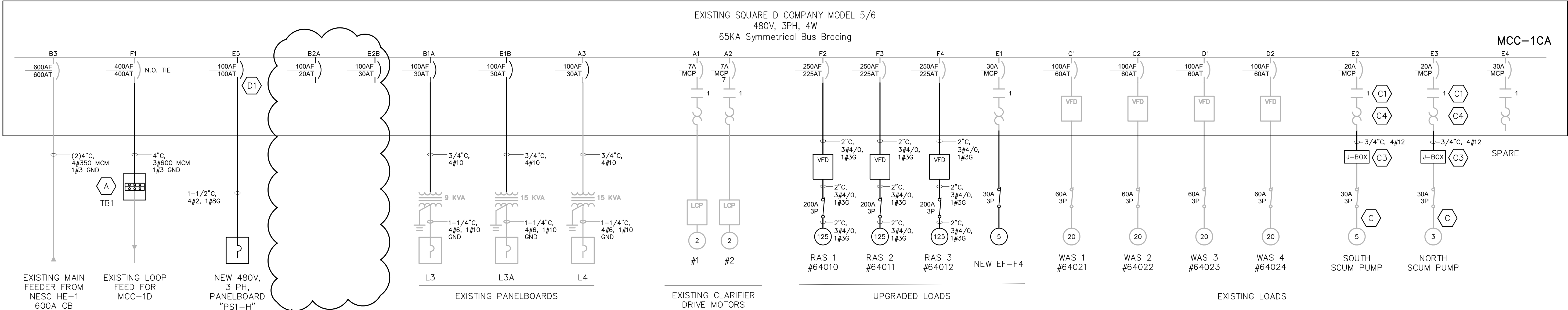
1621 N. 14th Avenue
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ADDENDUM NUMBER 1

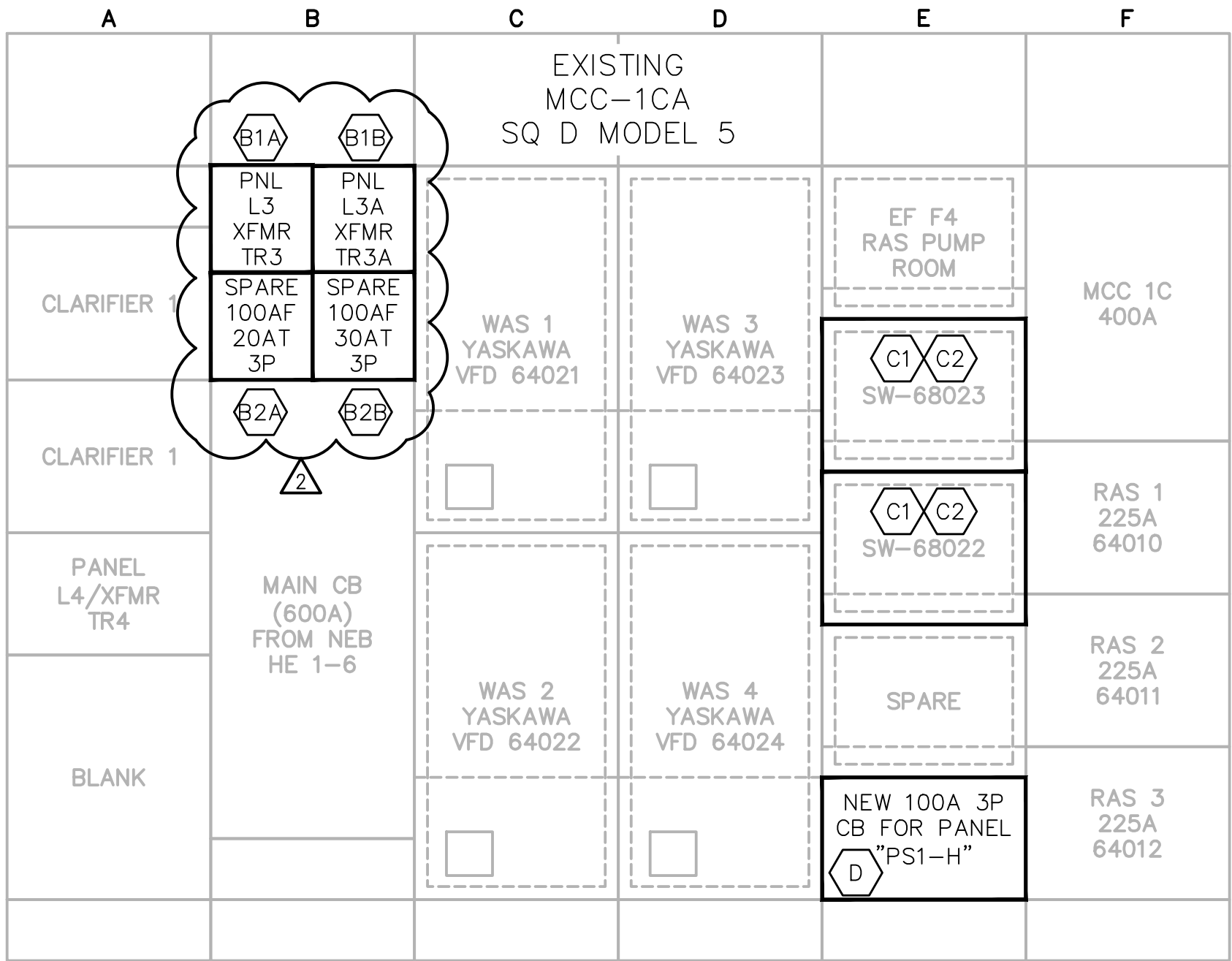
ALL OTHER TERMS, CONDITIONS AND SPECIFICATIONS SHALL REMAIN THE SAME.

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.

Clece Aurelius, P.E., ESS Manager
Department of Public Utilities – ECSD



EXISTING MCC-1CA SINGLE LINE DIAGRAM



EXISTING MCC-1CA – FRONT ELEVATION

SPS#1 ELECTRIC ROOM		RAS PS-1: PANEL "PS1-H" SCHEDULE <div>D</div>										100A MAIN LUGS				
480V, 3PH, 3W+G, 100A, 22kAIC FED FROM MCC-1CA NO NEUTRAL												NEMA 1 SURFACE MOUNT				
		kVA LOAD				C.B.			C.B.			kVA LOAD				
NO.	USE	A	B	C	WIRE	TRIP	POLE		POLE	TRIP	WIRE	A	B	C	USE	NO.
1	MOV-64012	0.5			3#12, 1#12G, 3/4C	20	3		3	20		0			SPARE	2
3			0.5										0			4
5				0.5										0		6
7	MOV-64010	0.5			3#12, 1#12G, 3/4C	20	3								SPACE	8
9			0.5												10	
11				0.5											12	
13	SITE LIGHTING CONTROLLER	1.0			2#10, 1#10G, 3/4C	20	2								SPACE	14
15			1.0												16	
17	SPARE			0.0		20	1								SPACE	18
19	SPACE														SPACE	20
21	SPACE														SPACE	22
23	SPACE														SPACE	24
25	SPACE														SPACE	26
27	SPACE														SPACE	28
29	SPACE														SPACE	30
		2.0	2.0	1.0								0.0	0.0	0.0		
											TOTAL kVA DEMAND	2	2	1	5	

KEYED NOTES:

A TERMINATION BOX NOTES:

1. NEW TERMINATION BOX (TB1) FOR EXTENDING THE LOOP FEEDER FROM MCC-1D TO MCC-1CA
2. TERMINATION BOX TB1 SHALL BE 304 STAINLESS STEEL, MINIMUM OF 18"W x 18"H x 12"D OPEN BOTTOM AND SHALL HAVE A TERMINAL STRIP SIZED TO TERMINATE NEW WIRING TO EXISTING WIRING.
3. TERMINATION BOX BOTTOM SHALL BE INSTALLED A MINIMUM OF 6" ABOVE FINISHED FLOOR.
4. EXISTING CONDUIT FROM MCC-1CA SHALL BE EXTENDED TO THE TERMINATION BOX.
5. NEW WIRES SHALL BE PROVIDED AND INSTALLED BETWEEN MCC-1CA AND THE NEW TERMINATION BOX.

B MCC-1CA NOTES:

1. CONTRACTOR SHALL PROVIDE AND INSTALL FOUR (4) NEW CIRCUIT BREAKERS IN MCC-1CA AS SHOWN ON THIS DRAWING.

C EXISTING SCUM PUMPS NOTES:

1. CONTRACTOR SHALL REPURPOSE EXISTING SEAL WATER SYSTEM MOTOR STARTERS SW-68022 AND SW-68023 FOR EXISTING SCUM PUMPS AT NORTH AND SOUTH ENDS. CONTRACTOR SHALL REPLACE EXISTING MOTOR OVERLOADS WITH OVERLOADS SIZED FOR THE ASSOCIATED PUMPS.
2. AFTER DEMOLITION OF MCC-1C, CONTRACTOR SHALL EXTEND WIRING FROM EXISTING SCUM PUMPS TO THE REPURPOSED MOTOR STARTERS IN MCC-1CA UTILIZING NEW JUNCTION BOX, CONDUIT AND WIRING AS REQUIRED FOR THE EXTENSION.
3. JUNCTION BOXES SHALL BE LOCATED ON WALL AFTER MCC-1C HAS BEEN DEMOLISHED. IT IS THE INTENT TO USE THE J-BOXES AS THE TRANSITION TERMINATION EXTENSION POINTS.

D PANEL PS1-H:

1. PROVIDE AND INSTALL NEW 100A 3P CB IN MCC-1CA TO FEED NEW 480V, 3P, 4W, 100A PANEL.

PLOT DATE: 11/6/2019 10:18 AM BY: TBOCAS

DESIGNED	JMB
DRAWN	JMB
CHECKED	JCB
PROJ. ENGR.	JCB

2	10/2019	ADDENDUM NO. 1	JPC
1	09/2019	BID SET	JPC
NO.	DATE	ISSUED FOR	BY

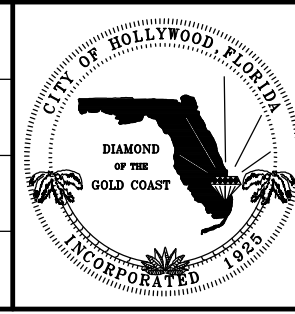
DESIGNED	JMB
DRAWN	JMB
CHECKED	JCB
PROJ. ENGR.	JCB

JOHN C. BURKE	P.E.
No. 17301	



SCALE	NONE
-------	------

CONTRACT:	-
CLIENTS PROJECT:	17-9523
ENGINEERS PROJECT:	4321-077
CAD REFERENCE:	4321-077-E06



CITY OF HOLLYWOOD

SOUTHERN REGIONAL WASTEWATER TREATMENT PLANT
RAS PUMP STATION No.1 REPLACEMENT
RAS PS-1: MCC-1CA AND PANEL PS1-H

DATE :	SEPTEMBER 2019
SHEET :	37 OF 49
DRAWING :	E-6

Pre-Bid Meeting - Agenda

City of Hollywood Southern Regional Wastewater Treatment Plant RAS Pump Station No. 1 Replacement

City Project No. 17-9523
H&S Project No. 4321-077

Location:	City of Hollywood Southern Regional Wastewater Treatment Plant ECSD Conference Room, Building A
Date/Time:	Tuesday, October 22, 2019 at 3:00 PM

1. Introductions
2. Summary of Work
3. Engineer's Estimate: \$3.6 Million
4. Bid Documents Description
 - Bidding Package
 - Specifications
 - Plans
5. Construction Schedule
6. Sequence of Construction/Construction Constraints
7. Questions
8. Site Visit

**City of Hollywood
Southern Regional Wastewater Treatment Plant
RAS PUMP STATION NO. 1 REPLACEMENT**

City Project No. 17-9523

Pre-Bid Conference Meeting Minutes

ATTENDEES: See Attached Sign In Sheets
DATE: October 22, 2019
TIME: 3:00 PM
LOCATION: Southern Regional Wastewater Treatment Plant ECSD
FILE: 4321-077

1. Introductions

Jeff Jiang is the Project Manager for the City of Hollywood. The Engineer is represented by Hazen and Sawyer.

2. Summary of Project

The project work at the Southern Regional Wastewater Treatment Plant (SRWWTP) includes replacement of RAS Pump Station No. 1, rehabilitation work at Oxygenation Trains 1 and 2, retrofitting plug valves with electric actuation at RAS Pump Station Nos. 2, 3, and 4, and replacement of pinch valves and flowmeters at RAS PS Nos. 3 and 4, including all general, civil, mechanical, structural, electrical, and instrumentation and controls work for a complete and operable system.

The RAS Pump Station No. 1 work entails removal and replacement of existing RAS pumps, pump suction piping and valves, pump discharge piping and valves, pump suction header piping, portions of WAS piping, Clarifier Nos. 1 and 2 drain piping, and other accessories. Architectural modifications to the building and structural rehabilitation, including crack and leak repairs at the effluent trough of Clarifier No. 2, is also part of this work.

At the MCC Building No. 1, the scope of work includes the removal and replacement of existing electrical distribution equipment, isolation transformers, and variable frequency drives, as well as installation of a new 480V, 3-phase panelboard.

3. Engineer's Estimate

The Engineer's Opinion of Probable Construction Cost is \$3.6 Million.

4. Bidding Document Description

The Contract Documents include the Bidding Package, Technical Specifications, and Plans. Potential bidders are responsible for confirming that they have a complete Contract Document package. In addition, potential bidders are advised to check the City of Hollywood's website for any Addenda that may be issued. It is noted that there will be at least one addendum issued which will include pre-bid conference meeting minutes and a list of the pre-bid conference attendees.

5. Construction Schedule

Substantial completion for the Oxygenation Trains 1 & 2 Deck Rehabilitation is 280 days from Notice to Proceed. Substantial Completion for project is 630 days from Notice to Proceed. Final completion is 660 days from Notice to Proceed, unless revised by addendum.

6. Sequence of Construction/Construction Constraints

Work must be performed to maintain plant operations, and shutdowns of Clarifier Nos. 1 and 2 during the RAS PS No. 1 replacement are limited. Pumps may not be removed and replaced simultaneously. Detailed requirements on sequence of construction and construction constraints are provided in Section 01520 of the Specifications.

City stated that under no circumstances may three (3) Clarifiers be out of service at one time.

7. Contractor Questions / Comments

All questions are to be submitted in writing (via email) to Jeff Jiang (fjiang@hollywoodfl.org) at the City of Hollywood no later than November 5, 2019. If your question was not addressed via Addenda, please then notify Jeff Jiang via phone (954-921-3930). Bids are due by 2 pm on November 12, 2019. Bidding Packages shall be submitted in triplicate (1 original and two copies). If a question that was submitted in writing by the stated deadline, was not addressed in the Addenda, please note the question on 00300-2 of the Proposal where Bidder acknowledges receipt of Addenda.

As a reminder, the project work is defined in the Contract Documents. Work shall be performed according to the Contract Documents, regardless of what may have been stated/not stated during the Pre-Bid meeting and Site Visit, unless explicitly revised in the Addenda.

Contractor questions that were presented during the Pre-Bid Meeting and were subsequently submitted in writing to the City of Hollywood are addressed in the Addenda.

Question/Comment 1:

Please review the structural repair scope at Oxygenation Trains 1 and 2.

Response:

The project work at Oxygenation Trains 1 and 2 is outlined in the Contract Documents. No interior tank repair is specified under the project scope. Work at Oxygenation Trains 1 & 2 is not anticipated to require Oxygenation Trains 1 & 2 to be removed from service.

Question/Comment 2:

Please discuss testing requirements of Oxygenation Trains 1 & 2 leak repair.

Response:

The project work at Oxygenation Trains 1 and 2 is outlined in the Contract Documents.

Question/Comment 3:

Will Epoxytec be considered as acceptable manufacturer for coating?

Response:

Per Section 09900, Paragraph 1.05, all painting materials shall be as manufactured by Themec, Carboline, Ameron, PPG, or Sherwin Williams, unless otherwise stated in the Contract Documents.

Question/Comment 4:

What are the normal work hours of the project?

Response:

Normal Contractor work hours at the Southern Regional WWTP are 7am to 5pm, Monday through Friday. The City noted that night or weekend work outside of these hours may be subject to overtime work for City inspectors, and the Contractor shall bear the cost of overtime City inspection which is \$85/hour. A Request for Services (RFS) must be submitted. Maintenance staff work Monday through Thursday.

Question/Comment 5:

What will be required for replacement of the plug valves on the Clarifier drains? Will line stops be required? Will the Contractor be required to bear a cost if "killing" a line is required?

Response:

Please refer to Section 01520 – Maintenance of Facilities and Sequence of Construction of the Contract Documents. Planned shutdowns must be coordinated with the City and performed by the City. A Request of Services (RFS) must be submitted to the City in advance of services, per the Contract Documents. The Contractor is responsible for disposal of all residuals/liquids within pipes.

Question/Comment 6:

Are there potential structural integrity issues for buildings where valves are being demolished and replaced adjacent to building?

Response:

No structural integrity issues are known at this time.

Question/Comment 7:

Please discuss location of disposal of clarifier liquids.

Response:

Please refer to Section 01520 – Maintenance of Facilities and Sequence of Construction of the Contract Documents for requirements of wastewater dewatering. The City stated during the Pre-Bid meeting that there is a nearby manhole that may be used for disposal of wastewater drained from the existing

*City of Hollywood
RAS Pump Station No. 1 Replacement
Pre-Bid Conference Meeting Minutes*

Clarifier structure and drain piping. A Request of Services (RFS) must be submitted to the City in advance of services, per the Contract Documents.

Question/Comment 8:

Is there work in the Clarifier channel like on the RAS Pump Station No. 2 project?

Response:

Yes, the work is addressed in the Contract Documents.

Question/Comment 9:

Does the City have a planned project start date?

Response:

The City estimates a Notice-To-Proceed in the 2nd quarter of 2020.

Question/Comment 10:

Please review the City of Hollywood's Local Preference stipulations and clarify whether they apply to this project.

Response:

Section 00435 of the Contract Documents addresses local preference stipulations which apply to the project. City Project Manager Jeff Jiang clarified that the local preference applies to the General Contractor, or Bidder, for this project provided they meet the qualifications.

Question/Comment 11:

Will badges be required for Contractor employees?

Response:

Badges are not required to be purchased for Contractor employees. The Contractor must submit a roster of all employees that will be onsite each day.

Question/Comment 12:

Does the City have soil borings in area where dewatering is required? Is soil contaminated in any areas?

Response:

The City stated no contaminated soil is present.

*City of Hollywood
RAS Pump Station No. 1 Replacement
Pre-Bid Conference Meeting Minutes*

Question/Comment 13:

In reference to Bid Drawing E-6, Note B, are the MCC cabinets readily available from Schneider and does Schneider need to perform this work directly to warrant the MCC Cabinet? On Bid Drawing E-6, Note B, what does “repurpose existing seal water system motor starters” mean?

Response:

Refer to attached Addenda No. 1 Drawing E-6 for clarification and revisions.

Question/Comment 14:

On Bid Drawing E-6, Note B, what does “repurpose existing seal water system motor starters” mean?

Response:

Refer to attached Addenda No. 1 Drawing E-6 for clarification and revisions.

Question/Comment 15:

In the areas where underground piping is proposed for replacement, there are sidewalks with existing cracks. Are cracked sidewalks to be replaced?

Response:

In areas of the proposed work, or areas damaged due to construction during the project, the Contractor is responsible for complete restoration of the site to existing or better condition, per the Contract Documents. Refer to Division 2 of the Contract Documents and the Drawings for sitework requirements. Sidewalks undisturbed during the project are not required to be replaced.

Question/Comment 16:

Will there be chlorine emergency drills during the project?

Response:

Yes, the City conducts chlorine emergency drills occasionally. The Contractor will be required to attend. The drills last no more than 30 minutes at a time. The City stated that the Contractor may assume the total duration of chlorine emergency drills is estimated at one work day throughout the entire project duration.

Question/Comment 17:

Are there any building permit requirements for this project?

Response:

As the project work is rehabilitation/repair work, the City stated they do not expect any building department permitting. However, there is an allowance account for permits/licenses.

Question/Comment 18:

Are there any Small Business Enterprise (SBE) or minority business requirements?

*City of Hollywood
RAS Pump Station No. 1 Replacement
Pre-Bid Conference Meeting Minutes*

Response:

The City encourages the use of local minority contractors and suppliers, however there is no City code that requires the use of SBEs. Please refer to Section 00435 of the Contract Documents and previous question regarding Local Preference.

Question/Comment 19:

Is there a preferred or required System Integrator on this project?

Response:

The system integration requirements are referred to in the Contract Documents. Please refer to Sections 17000, 01025, and 00420 List of Subcontractors, as well as any other applicable sections of the Contract Documents.

Question/Comment 20:

Please clarify the Alternate Bid Item A-1 Sectional Cured-In-Place (CIPP) Lining at RAS PS No. 1. Where is the section of pipe to be lined and what is the diameter? Does the Alternate Bid Item have to be Bid, or can it be left out? Is the project going to be awarded on the Base Bid, or the total that includes the Alternate Bid Item?

Response:

The diameter and section of pipe to be lined is indicated in the Drawings. The Alternate Bid Item A-1 shall be a net increase or decrease to Base Bid Item No. 2. Please refer to the Contract Documents, specifically Sections 01025 – Basis of Payment and 02772 Cured-In-Place Pipe Reconstruction of Pressurized Pipe. Per Section 01025, Alternate Bid Items are at the City's option and shall not be included in the Total Base Bid, shall not affect the Contract Award, and shall not affect substantial and final completion requirements.

Question/Comment 21:

Do you have existing Drawings of the underground piping at the Plant?

Response:

Included in the Bid Documents is an Appendix that includes Record Drawings of the plant site.

8. Site Visit

A site visit was conducted at the RAS Pump Station No. 1 and Oxygenation Trains 1 & 2.

c: *Attendees
T. VanEyck
File 4321-073*



4000 Hollywood Boulevard
Seventh Floor, North Tower
Hollywood, Florida 33021
(954) 987-0066
Fax: (954) 987-2949

CITY OF HOLLYWOOD SOUTHERN REGIONAL WWTP
RAS PUMP STATION NO. 1 REPLACEMENT
CITY PROJECT NO. 17-9523 / H&S PROJECT NO. 4321-077
PRE-BID MEETING SIGN-IN

October 22, 2019

Name	Company	Phone	Email Address
Tara Haneck	Hazen	954-987-0066	thaneck@hazendesign.com
Carla Maldonado	CEI Construction	786-287-9903	carlos@cicdinc.com
Jeff Jiang	COH	954-921-3930	fjiang@hollivoodfl.gov
Richard Stahl	Lawrence Utterst.	561-578-7715	Richard.Stahl@lucanconstruction.com
Ignacio Arias	Epoxytec Inc.	754-445-3707	arias@epoxytec.com
Arthur Nelson	Emmerson Partners	954-325-9834	wilson-partners@comcast.net
Nitish Krishnan	TLC Diversified, Inc.	941-722-0621	bidg@tlediv.com
Joseph Loggia	Loggia	305-244-2866	JosephLoggia@loggia.com
Jose Sierra	Comtech Engineering	305-969-2140	JSierra@Comtecheng.com
Jeff Wiley	Wharton-Smith	561-222-6419	jwiley@whartonsmith.com
Brian Williams	Wharton-Smith	561-746-5956	bwilliams@whartonsmith.com
Alex Azor	Tou Evans Environmental	305-343-9295	aa@touevans.com
Jeff Hestrick	Cypress Construction	754-822-8427	Jeff@Cypresscc.net

Hazen

Name	Company	Phone	Email Address
Jessie Foster DM Clarke	Southland Painting Florida Design Contr.	954-854-3138 561-275-2280	Jessiea@SouthlandPainting.com TClarke@FloridaDesignContractors.com
Dea Zello	Reynolds	954.650.0164	OSCAR.BELL@GREGGUSDSCA.COM
Eric Jones	INTEROUNT ENGINEERING	954-972-9800	BDS@REFENGINEERING.COM
MHE BRAUN	BARNES PUMPS	212-444-8094	BRAUNM@BARNESPUMPS.COM
JOSE E. RODRIGUEZ	BUDM USA, LLC	787-379-9499	jerdad@bldmtr.com
Cory Moshko	Cott	954-921-3288	CMoshko@hollymoodfl.org
DAVID REYER	REYER CONSULTING CONSULTANTS, INC.	412-230-6715 cell 754-206-2963 office	DAVID@REYERCONSULTING.COM
Justin Robaina	V-Engineering	786-416-5750	justin@vecorp.net
Victor H. Serrano	Lano Co.	954.703.0209	estimating@lanoz.ors
Kelly Strickles	Cott	954 921 3288	Kmstrickles@hollymoodfl.org
Yoel Roaen	Power and Pumps Inc.	854-343-0400	YRoaen@powerandpumps.com
Jose Polanco	Civil	954-9213288	JMPolanco@HollymoodFl.org
Francisco Rodriguez	Cott	954 980 0042	FranciscoRodriguez@

TECHNICAL SPECIFICATIONS

DIVISION 1 – GENERAL REQUIREMENTS

SECTION 01010 - SUMMARY OF WORK

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The work to be performed under this Contract shall consist of furnishing all tools, equipment, materials, supplies, and manufactured articles and for furnishing all transportation and services, including fuel, power, water, and essential communications, and for the performance of all labor, work, or other operations required for the fulfillment of the Contract in strict accordance with the Contract Documents. The work shall be complete, and all work, materials, and services not expressly shown or called for in the Contract documents which may be necessary for the complete and proper construction of the work in good faith shall be performed, furnished, and installed by the CONTRACTOR as though originally so specified or shown, at no increase in cost to the CITY.
- B. Prior to construction, the CONTRACTOR shall verify existing utilities identified on the Drawings and locate other potential utilities in their working area that may not be shown on the Drawings. The utility verifications consist of excavation to verify tie-in points and to locate potential conflicts that may affect the work as shown on the Drawings. The CONTRACTOR shall be responsible for the coordination of this work with the associated utility owners and permitting agencies having jurisdiction over the specific locations to be verified.

1.02 SCOPE

- A. The work to be performed includes site, civil, sitework, mechanical, structural, architectural, electrical, instrumentation and all related work associated with the following:
 - RAS Pump Station No. 1: This work consists of removal and replacement of RAS pumps, removal and replacement of pump suction and pump discharge piping and valves, removal and replacement of pump suction header piping and valves, removal and replacement of existing portion of WAS piping including flow meter and pinch valve, replacement of appurtenant piping, architectural modifications to the building, structural rehabilitation and coating of the entire RAS Pump Station (interior and exterior), and all related electrical, instrumentation, and controls work. This work also includes demolition and replacement of buried piping and valves exterior to the pump station, as indicated on the drawings, including complete restoration. In addition, this work includes all construction sequencing requirements, all startup and training activities, and all other work required for a complete and operating facility.
 - MCC Building No. 1: This work consists of demolition of existing electrical distribution equipment including MCC-1C, wiring, isolation transformers, and variable frequency drives for RAS Pump Nos. 1, 2, and 3. Work also includes replacement of RAS Pump Nos. 1, 2 and 3 and associated wiring, with modifications to the existing MCC-1CA to accommodate transfer of loads from MCC-1C, and installation of a new 480V, 3-phase panelboard. In addition, this

work includes all construction sequencing requirements, and all other work required for a complete and operating facility.

- Oxygenation Train Nos. 1 and 2 Rehabilitation: The work consists of structural rehabilitation to the Oxygenation Tanks, as indicated in the Contract Documents. Patch repair and coating to rehabilitated areas are considered incidental and shall be included in the work. In addition, this work includes all construction sequencing requirements, and all other work required for a complete and operating facility.
- Oxygenation Train Nos. 1 and 2 18-inch RAS Valves – Electric Actuation Retrofit: This work consists of retrofitting two (2) 18-inch plug valves with electric actuation, as indicated in the Contract Documents, and includes all general, civil, mechanical, structural, electrical, and instrumentation and controls work.
- RAS Pump Station No. 2 16-inch RAS Valves – Electric Actuation Retrofit: This work consists of retrofitting two (2) 16-inch plug valves with electric actuation, as indicated in the Contract Documents, and includes all general, civil, mechanical, structural, electrical, and instrumentation and controls work.
- RAS Pump Station Nos. 3 and 4: This work consists of retrofitting two (2) 30-inch plug valves with electric actuation, as well as replacement of 6-inch pinch valves and flowmeters, as indicated in the Contract Documents, and includes all general, civil, mechanical, structural, electrical, and instrumentation and controls work.
- Alternate Bid Item No. A-1 – Sectional Cured-In-Place Pipe (CIPP) Lining: This work includes cured-in-place pipe (CIPP) lining of a section of existing 16-inch RAS suction pipe at RAS PS No. 1, as indicated in the Contract Documents. This work is in lieu of replacement of the stairs, wall pipe, and related repair work at RAS Pump Station No. 1.
- Alternate Bid Item No. A-2 – Additional Instrumentation and Controls System Integration: This work includes all labor, equipment and materials for additional controls system integration work, as needed for the project.
- Alternate Bid Item No. A-3 – Procure Two (2) 24-inch Ball Valves for City Deep Injection Well No. 1: Include all work necessary and required to procure two (2) ball valves for Deep Injection Well No. 1 and furnish to the City for replacement.

- B. It is the intent of the CITY to obtain a complete and working installation under this contract and any items of labor, materials or equipment, which may reasonably be assumed as necessary to accomplish this end, should be supplied whether or not specifically shown on the plans or described herein. Maintenance of existing operations is mandated throughout the construction period.

1.03 WORK BY OTHERS

- A. The CONTRACTOR shall cooperate fully with all utility forces of the CITY, or other public or private agencies engaged in the relocation, altering, or otherwise rearranging

of any facilities which interfere with the progress of the work, and shall schedule the work so as to minimize interference with said relocation, altering, or rearranging of facilities.

- B. The CONTRACTOR's attention is directed to the fact that work will be conducted at the site by other contractors during the performance of the work under this Contract. The CONTRACTOR shall conduct its operations so as to cause a minimum of interference with the Work of such other contractors, and shall cooperate fully with such contractors to provide continued safe access to their respective portions of the site, as required to perform their respective contracts.
- C. When two or more contracts are being executed at one time on the same or adjacent land in such manner that Work on one contract may interfere with that on another, the CITY shall determine the sequence and order of the Work. When the territory of one contract is the necessary or convenient means of access for the execution of another contractor, such privilege of access or any other reasonable privilege may be granted by the CITY to CONTRACTOR.

1.04 LOCATION OF THE PROJECT

- A. The project is located at the City of Hollywood's Southern Regional Wastewater Treatment Plant at 1621 North 14th Avenue, Hollywood, Florida.

1.05 CONTRACT DRAWINGS

- A. The work to be performed is shown on the set of Contract Drawings entitled "City of Hollywood Southern Regional Wastewater Treatment Plant, RAS Pump Station No. 1 Replacement".

1.06 CONTRACTOR FURNISHED MATERIAL AND EQUIPMENT

- A. All equipment, materials, or devices incorporated in this project shall be new and unused, unless indicated otherwise in the Contract Documents and shall be the products of reliable manufacturers who, unless otherwise specified, have been regularly engaged in the manufacture of such material and equipment for at least five (5) years. Procedures and additional requirements regarding manufacturer's experience and substitutions are included in Section 01300 - Submittals.

1.07 DRAWINGS OF EXISTING FACILITIES

- A. Drawings of the existing facilities may be inspected at the City Engineering Support Services Office. These drawings are for information only and are not a part of the Contract Documents. In making these drawings available for inspection, the CITY makes no guarantee, either expressed or implied, as to their accuracy or completeness.

1.08 ITEMS SPECIFIED ON DRAWINGS

- A. Certain items of material and/or equipment, and their installation may be specified on the Drawings and not mentioned in the Specifications. Such items are to be considered as both shown on the Drawings and noted in the Specifications and be provided by the CONTRACTOR in accordance with the Specification on the Drawings.

1.09 FIELD LAYOUT OF WORK

- A. All work under this Contract shall be constructed in accordance with the lines and grades shown on the Contract Drawings or as directed by the ENGINEER. Elevations of existing ground, structures and appurtenances are believed to be reasonably correct but are not guaranteed to be absolute and therefore are presented only as an approximation. Any error or apparent discrepancy in the data shown or omissions of data required for accurately accomplishing the stake-out survey shall be referred immediately to the ENGINEER for interpretation or correction.
- B. All survey work for construction control purposes shall be made by the CONTRACTOR at his expense.
- C. The CONTRACTOR shall establish all base lines for the location of the principal component parts of the work together with benchmarks and batter boards adjacent to the work. Based upon the information provided by the Contract Drawings, the CONTRACTOR shall develop and make all detail surveys necessary for construction. The CITY will furnish information and location of existing benchmarks.
- D. The CONTRACTOR shall have the responsibility to carefully preserve the benchmarks, reference points and stakes. In case of destruction thereof by the CONTRACTOR or resulting from his negligence, he shall be held liable for any expense and damage resulting therefrom and shall be responsible for any mistakes that may be caused by the unnecessary loss or disturbance of such bench marks, reference points and stakes.
- E. Existing or new control points, property markers, and monuments that will be established or are destroyed during the normal causes of construction shall be re-established by the CONTRACTOR; and all reference ties recorded therefore shall be furnished to the ENGINEER. All computations necessary to establish the exact position of the work shall be made and preserved by the CONTRACTOR.
- F. The ENGINEER may check all or any portion of the work, and the CONTRACTOR shall afford all necessary assistance to the ENGINEER in carrying out such checks. Any necessary corrections to the work shall be performed immediately by the CONTRACTOR and he shall accept all responsibility for the accuracy and completeness of his work.

PART 2 -- PRODUCTS (Not Used)

PART 3 -- EXECUTION (Not Used)

- END OF SECTION -

SECTION 01011 - SPECIAL INSPECTIONS

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. The CONTRACTOR, in accordance with Section 109.11 of the Broward County Administrative Code and the Florida Building Code, shall retain a Special Inspector to perform the applicable inspections outlined in Sections 109.11, 1822, 2122.4, 2223.11.1, 1927.12.1, and 1927.12.2 of 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 where applicable:
 - 1. Precast concrete units – Section 1927.12.1 and 109.11.2.1;
 - 2. Precast concrete units – Section 1927.12.2 and 109.11.2.1;
 - 3. Reinforced unit masonry – Section 2122.4 and 109.11.2.2 (per ACI 530.1-05-Level B Quality Assurance unless noted otherwise on the Drawings);
 - 4. Connections – Section 2218.2 and 109.11.2.3
 - 5. Metal Building Systems – Section 2223.11.1 and 109.11.2.4
- D. Additional inspections may be required at the discretion of the Building Official per Section 109.11.1.1 of the Broward County Administrative Code and 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.
- 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 CITY.

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 Sections 109.11.6 of 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 Certificate of Compliance prior to scheduling the final building inspection in accordance with Section 109.11.7 of the Building Code.
- B. The Certificate of Compliance shall state that the work performed by the CONTRACTOR was done 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 01025 - BASIS OF PAYMENT

PART 1 -- GENERAL

1.01 GENERAL

- A. Payments to the CONTRACTOR shall be made on the basis of the Proposal bid items as full and complete payment for furnishing all materials, labor, tools and equipment, and for performing all operations necessary to complete the work included in the Contract Documents. Such compensation shall also include payments for any loss or damages arising directly or indirectly from the work, or from any discrepancies between the actual quantities of work and those shown in the Contract Documents, or from any unforeseen difficulties which may be encountered during the prosecution of the work until the final acceptance by the CITY.
- B. The prices stated in the proposal include all costs and expenses for taxes, labor, equipment, materials, commissions, transportation charges and expenses, patent fees and royalties, labor for handling materials during inspection, together with any and all other costs and expenses for performing and completing the work as shown on the plans and specified herein. The Basis of Payment for an item at the price shown in the Proposal shall be in accordance with its description of the item in this Section and as related to the work specified and as shown on the Drawings. Unit prices where used will be applied to the actual quantities furnished and installed in conformance with the Contract Documents.
- C. The CONTRACTOR's attention is called to the fact that the quotations for the various items of work are intended to establish a total price for completing the work in its entirety. Should the CONTRACTOR feel that the cost of any item of work has not been established by the Proposal or Basis of Payment, he shall include the cost for that work in the last Bid Item so that his proposal for the project does reflect his total price for completing the work in its entirety.

1.02 MEASUREMENT

- A. The quantities for payment under this Contract shall be determined by actual measurement of the completed items, in place, ready for service and accepted by the CITY, in accordance with the Schedule of Payment Values as described in Section 01300, unless otherwise specified. A representative of the CONTRACTOR shall witness all field measurements.

1.03 PAYMENT ITEMS

A. Base Bid Items

1. Item No. 1 – Mobilization: The lump sum price bid for this item shall be 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 3% of the sum of Bid Item Nos. 2 through 8.
2. Item No. 2 – All Work Associated with the RAS Pump Station No. 1 Replacement: Payment for all labor, equipment and material for all work necessary and required for the replacement of RAS Pump Station No. 1 as required in the Contract Documents. This item includes, but is not limited to, all general, civil, mechanical, structural, concrete rehabilitation, architectural, electrical, instrumentation and control, equipment testing, startup services and construction sequencing requirements required for a complete and operable system. Concrete rehabilitation work includes, but is not limited to, surface preparation, concrete repair work, reinforcement replacement, interior coating application, and exterior painting. Electrical work includes all work necessary and required for the removal and salvage of sections of the existing motor control center MCC-1C, variable frequency drives for RAS Pumps 1, 2 and 3, isolation transformers and associated wiring. Also included is installation of new variable frequency drives for RAS Pumps 1, 2 and 3, associated wiring and equipment, existing motor control center MCC-1CA modifications, and installation of a new 480V, 3-phase panelboard. Included in this bid item is payment for all labor, equipment and material for all work necessary and required for the removal and replacement of up to 750 linear feet of Schedule 80 PVC piping, 3 inches in diameter or less and the removal and replacement of up to ten isolation ball valves, 3 inches in diameter or less not already shown to be removed and replaced on the Drawings. Item No. 2 includes all work not defined in other Bid items.
3. Item No. 3 – All Work Associated with Leak Repairs at RAS Pump Station / Clarifier: Payment for all labor, equipment and material for all work necessary and required for leak repairs using a waterproof injection grout system and waterproof membrane system on the RAS Pump Station Walls or Clarifier walls as required in the Specifications and described herein for which payment is not provided under other bid items. Work also includes construction joint repair along inside of clarifier effluent trough and application of cementitious waterproofing. This item includes, but is not limited to, mobilization(s) of all required equipment, the provision of all labor, materials and equipment for leak repairs. Costs for installation of ancillary items such as drilling of holes, installation, removal and patching of ports, curing, cleaning of equipment, etc. shall be included in the lump sum price.
4. Item No. 4 – All Work Associated with Oxygenation Train Nos. 1 and 2 Patch and Leak Repair: Payment for all labor, equipment and material for all work necessary and required for structural rehabilitation of the Oxygenation Train Nos. 1 and 2, as required in the Drawings and Specifications. This item includes, but is not limited to,

mobilization(s) of all required equipment and the provision of all labor, materials and equipment for patch and leak repairs. Costs for installation of ancillary items such as drilling of holes, installation, removal and patching of ports, curing, cleaning of equipment, painting patchwork and restoration of final surface, etc., shall be included in the lump sum price.

5. Item No. 5 – All Work Associated with Retrofit of Existing 18-inch RAS Valves at Oxygenation Trains 1 and 2 with Electric Actuation: Payment for all labor, equipment and material for all work necessary and required for the retrofit of existing 18-inch buried plug valves with electric actuation, as required in the Drawings and Specifications. This item includes, but is not limited to, all general, civil, mechanical, structural, electrical, instrumentation and control, equipment testing, startup services and construction sequencing requirements required for a complete and operable system.
6. Item No. 6 – All Work Associated with Retrofit of Existing 16-inch RAS Valves at RAS Pump Station No. 2 with Electric Actuation: Payment for all labor, equipment and material for all work necessary and required for the retrofit of existing 16-inch plug valves with electric actuation, as required in the Drawings and Specifications. This item includes, but is not limited to, all general, civil, mechanical, structural, electrical, instrumentation and control, equipment testing, startup services and construction sequencing requirements required for a complete and operable system.
7. Item No. 7 – All Work Associated with RAS Pump Station No. 3: Payment for all labor, equipment and material for all work necessary and required for the retrofit of existing 30-inch plug valve with electric actuation, and replacement of 6-inch pinch valve and flowmeter, as required in the Drawings and Specifications. This item includes, but is not limited to, all general, civil, mechanical, structural, electrical, instrumentation and control, equipment testing, startup services and construction sequencing requirements required for a complete and operable system.
8. Item No. 8 – All Work Associated with RAS Pump Station No. 4: Payment for all labor, equipment and material for all work necessary and required for the retrofit of existing 30-inch plug valve with electric actuation, and replacement of 6-inch pinch valve and flowmeter, as required in the Drawings and Specifications. This item includes, but is not limited to, all general, civil, mechanical, structural, electrical, instrumentation and control, equipment testing, startup services and construction sequencing requirements required for a complete and operable system.
9. Item No. 9 – Inspections and Testing: The allowance account for this item is to pay for all labor, equipment and materials for all work necessary and required for special inspections and testing. This item includes payment of a licensed Professional Engineer to perform all special inspections as required by the Florida Building Code, all discretionary special inspections as required by the City of Hollywood Building Department, inspections and testing during concrete pours, completion of all inspection reports, and completion/submittal of the Certification of Compliance. This item also includes all work necessary and required for NACE certified personnel to provide inspections of surface preparation work and post coating application work as described in the Contract Documents. This item also includes payment of testing requested by

CITY or ENGINEER. The allowance shown on the Proposal Bid Form is an estimate of services required. Payment will be based on the actual fee paid directly to the Special Inspector, the NACE Inspector, or the testing laboratory; 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. Special inspector(s) and NACE Certified Inspector(s) to perform work shall be approved by the City in advance. Personnel, site visits and cost to perform work must be approved by the City in advance. The cost of any required inspection or any required test which CONTRACTOR fails shall be paid for by CONTRACTOR.

10. Item No. 10 - Permits, Licenses and Fee Allowance for Government Agencies: The allowance account indicated for this item is to pay for all permits, licenses and other fees required of the CONTRACTOR from the various agencies having jurisdiction for construction of the project. The allowance shown on the Proposal 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.
11. Item No. 11 – 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 CITY. Amount to be paid per undefined conditions or conflicts shall be negotiated or agreed to by both parties.
12. Item No. 12 – Consideration for Indemnification: In recognition of CONTRACTOR's indemnification obligations, the CITY 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 CITY after receipt of the progress payment.
13. Item No. 13 – Demobilization: Payment for completing all work including but not limited to demobilization, site cleanup and restoration - all as per the Technical Specifications and Contract Drawings. The payment items for demobilization shall not exceed 2% of the sum of Bid Item Nos. 2 through 8.

B. Alternate Bid Items

The following items are at the CITY's option and shall not be included in the Total Base Bid.

- A-1. Item No. A-1 – Sectional Cured-In-Place Pipe (CIPP) Lining at RAS PS No. 1: Item shall include all work necessary and required for cured-in-place (CIPP) lining of existing 16-inch RAS suction pipe at RAS PS No. 1, as indicated in the Drawings and required in the Specifications, for a complete and operable system. Alternative Bid Item A-1 work is in lieu of replacement of the entrance stairs and wall pipe, including associated repairs, under Bid Item No. 2. The payment item for Alternate Bid Item A-1 shall be a net increase or decrease in Base Bid Item No. 2.

A-2. Item No. A-2 – Additional Instrumentation and Controls System Integration: Item shall include all labor, equipment and materials for additional instrumentation and controls system integration work to be performed by the System Integrator, as needed, for Base Bid Items 2 and 5 through 8. Additional controls system integration work shall consist of:

- a. Any modifications to the existing PLC logic for any of the PLCs being modified (under the Base Bid work), excluding the following already provided under the Base Bid: point to point loop checks and troubleshooting of signals being modified or added to the PLC cabinets requiring the PLC program to be opened and viewed, but not modified, and basic modifications to the PLC program limited to changing a PLC I/O point physical address or changing PLC analog scaling.
- b. Any modifications to existing PLC logic, including modifications to existing automatic control strategies and/or development of new automatic PLC control strategies or changes to the CITY's standard PLC logic function blocks
- c. Any modifications to SCADA HMI screen graphics excluding the following already provided under the Base Bid: using existing SCADA HMI screen development software to perform Simple text modifications, PLC I/O mapping changes or analog signal scale representation adjustment.
- d. Any modification of existing, or development of new, SCADA HMI screens or the CITY's standard valve or pump faceplate graphic templates.

The payment item for Alternate Bid Item A-2 shall be a net increase in the Base Bid upon approval by the ENGINEER and CITY.

A-3. Item No. A-3 – Procure Two (2) 24-inch Ball Valves for City Deep Injection Well No. 1: Item shall include all work necessary and required to procure two (2) ball valves for Deep Injection Well No. 1 and furnish to the City for replacement. Ball valves shall be manufactured by PRATT and shall be 24-inch flanged 250#, 125# drilled double seated / rubber seated with ductile iron body and ductile iron ends, including MDT-6S manual actuator with hand wheel-open left design. Valves shall be interior/exterior/operator coated with 8 mils NSF Epoxy. The payment item for Alternate Bid Item A-3 shall be a net increase in the Base Bid.

PART 2 -- PRODUCTS (Not Used)

PART 3 -- EXECUTION (Not Used)

- END OF SECTION -

SECTION 01070 - ABBREVIATIONS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. Wherever in these specifications references are made to the standards, specifications, or other published data of the various national, regional, or local organizations, such organizations may be referred to by their acronym or abbreviation only. As a guide to the user of these specifications, the following acronyms or abbreviations which may appear in these specifications shall have the meanings indicated herein.

1.02 ABBREVIATIONS AND ACRONYMS

AAMA	Architectural Aluminum Manufacturer's Association
AASHTO	American Association of the State Highway and Transportation Officials
ACI	American Concrete Institute
ACIFS	American Cast Iron Flange Standards
ACOE	Army Corps of Engineers
ACPA	American Concrete Pipe Association
AFBMA	Anti-Friction Bearing Manufacturer's Association, Inc.
AGMA	American Gear Manufacturer's Association
AHGDA	American Hot Dip Galvanizers Association
AI	The Asphalt Institute
AIA	American Institute of Architects
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AITC	American Institute of Timber Construction
AMCA	Air Moving and Conditioning Association
ANSI	American National Standards Institute, Inc.
APA	American Plywood Association
API	American Petroleum Institute
APHA	American Public Health Association
APWA	American Public Works Association
ASA	Acoustical Society of America
ASAE	American Society of Agriculture Engineers
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating, and Air-Conditioning Engineers
ASLE	American Society of Lubricating Engineers

ASME	American Society of Mechanical Engineers
ASMM	Architectural Sheet Metal Manual
ASSE	American Society of Sanitary Engineers
ASTM	American Society for Testing and Materials
AWPA	American Wood Preservers Association
AWPI	American Wood Preservers Institute
AWS	American Welding Society
AWWA	American Water Works Association
BCEPGMD	Broward County Environmental Protection and Growth Management Department (formerly BCEPD)
BCHD	Broward County Health Department
CEMA	Conveyor Equipment Manufacturer's Association
CMA	Concrete Masonry Association
CRSI	Concrete Reinforcing Steel Institute
DIPRA	Ductile Iron Pipe Research Association
EIA	Electronic Industries Association
ETL	Electrical Test Laboratories
FBC	Florida Building Code
FDEP	Florida Department of Environmental Protection
FDOT	Florida Department of Transportation
FS	Federal Specifications
IEEE	Institute of Electrical and Electronics Engineers
IES	Illuminating Engineering Society
IPCEA	Insulated Power Cable Engineers Association
ISA	Instrument Systems and Automation
ISO	International Organization for Standardization
MBMA	Metal Building Manufacturers Association
MMA	Monorail Manufacturers Association
MTI	Marine Testing Institute
NAAM	National Association of Architectural Metal Manufacturers
NACE	National Association of Corrosion Engineers
NBS	National Bureau of Standards
NEC	National Electrical Code
NEMA	National Electrical Manufacturer's Association
NFPA	National Fire Protection Association

NIOSH	National Institute of Occupational Safety and Health
NIST	National Institute of Standards and Testing
NRCA	National Roofing Contractors Association
NSF	National Science Foundation
OSHA	Occupational Safety and Health Administration
PCA	Portland Cement Association
PCM	Program Construction Manager
PMT	Program Management Team
SFWMD	South Florida Water Management District
SMACCNA	Sheet Metal and Air Conditioning Contractors National Association
SSPC	Steel Structures Painting Council
SSPWC	Standard Specifications for Public Works Construction
SFWMD	South Florida Water Management District
UL	Underwriters Laboratories, Inc.

PART 2 -- PRODUCTS

(NOT USED)

PART 3 -- EXECUTION

(NOT USED)

- END OF SECTION –

SECTION 01090 - REFERENCE STANDARDS

PART 1 -- GENERAL

1.01 WORK INCLUDED

- A. Titles of Sections and Paragraphs: Captions accompanying specification sections and paragraphs are for convenience of reference only, and do not form a part of the Specifications.
- B. Applicable Publications: Whenever in these Specifications references are made to published specifications, codes, standards, or other requirements, it shall be understood that wherever no date is specified, only the latest specifications, standards, or requirements of the respective issuing agencies which have been published as of the date of the opening of bids, shall apply; except to the extent that said standards or requirements may be in conflict with applicable laws, ordinances, or governing codes. No requirements set forth herein or shown on the Drawings shall be waived because of any provision of, or omission from, said standards or requirements.
- C. Specialists, Assignments: In certain instances, Specification text requires (or implies) that specific work is to be assigned to specialists or expert entities, who must be engaged for the performance of that work. Such assignments shall be recognized as special requirements over which the CONTRACTOR has no choice or option. These requirements shall not be interpreted so as to conflict with the enforcement of building codes and similar regulations governing the Work; also they are not intended to interfere with local union jurisdiction settlements and similar conventions. Such assignments are intended to establish which party or entity involved in a specific unit of work is recognized as "expert" for the indicated construction processes or operations. Nevertheless, the final responsibility for fulfillment of the entire set of Contract requirements remains with the CONTRACTOR.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Without limiting the generality of other requirements of the specifications, all work specified herein shall conform to or exceed the requirements of all applicable codes.
- B. References herein to "Building Code" shall mean the Florida Building Code. The latest edition of the code as approved and used by the local agency as of the date of the Building Department Permit Approval, as adopted by the agency having jurisdiction, shall apply to the Work herein, including all addenda, modifications, amendments, or other lawful changes thereto.
- C. In case of conflict between codes, reference standards, Drawings and the other Contract Documents, the most stringent requirements shall govern. All conflicts shall be brought to the attention of the ENGINEER for clarification and directions prior to ordering or providing any materials or labor. The CONTRACTOR shall bid the most stringent requirements.
- D. Applicable Standard Specifications: The CONTRACTOR shall construct the Work specified herein in accordance with the requirements of the Contract Documents and the referenced portions of those referenced codes, standards, and Specifications listed herein.

- E. References herein to "OSHA Regulations for Construction" shall mean Title 29, Part 1926, Construction Safety and Health Regulations, Code of Federal Regulations (OSHA), including all changes and amendments thereto.
- F. References herein to "OSHA Standards" shall mean Title 29, Part 1910, Occupational Safety and Health Standards, Code of Federal Regulations (OSHA), including all changes and amendments thereto.

PART 2 -- PRODUCTS

(NOT USED)

PART 3 -- EXECUTION

(NOT USED)

- END OF SECTION -

SECTION 01200 - PROJECT MEETINGS

PART 1 -- GENERAL

1.01 PRECONSTRUCTION

- A. A preconstruction meeting will be held to acquaint representatives of the CITY and various agencies with those in responsible charge of the CONTRACTOR's activities for the project. The meeting will cover such subjects as the following: insurance certificates; permits and licenses; affirmative action employment; construction schedules; cost breakdown and application for payments; material deliveries, storage and payments; shop drawings and submittals; job-site inspection by the ENGINEER; safety and emergency action procedures; operations of the existing treatment facilities; field offices, security and other housekeeping procedures; list of subcontractors; liquidated damages; communications; coordinating; and other appropriate matters.

1.02 PROGRESS

- A. A progress meeting shall be held on a bi-weekly basis for the purpose of coordinating and expediting the work. The CONTRACTOR, as a part of his obligations under the Contract, shall attend in person or by an authorized representative to attend and to act on his behalf. The ENGINEER will conduct such meetings and as necessary, with the CONTRACTOR's input, issue an agenda.
- B. In addition, the ENGINEER or CONTRACTOR may call for special job site meetings for the purpose of resolving unforeseen problems or conflicts which may impede the construction schedule. The ENGINEER will prepare a brief summary report of the decisions or understandings concerning each of the items discussed at the meeting.
- C. At bi-weekly progress meetings, the CONTRACTOR shall submit to the ENGINEER for review a current three (3) week progress schedule. This schedule submission shall include a two week look ahead schedule and reflect status of the work performed during the preceding week.

PART 2 -- PRODUCTS (Not Used)

PART 3 -- EXECUTION (Not Used)

- END OF SECTION -

SECTION 01300 - SUBMITTALS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. This section specifies the means of all submittals. All submittals, whether their final destination is to the CITY, ENGINEER, or other representatives of the CITY, shall be directed from the CONTRACTOR through the ENGINEER. A summary of the key types of submittals and the number of copies required is as follows:

<u>Copies to ENGINEER</u>	<u>Type of Submittal</u>
6 ¹	Construction schedule
6	Schedule of payment items
1	Audio visual preconstruction record
6	Progress estimates
6	Shop drawings
4	Certificates of compliance
2	Warranties
2 ²	Product samples
5 ²	O&M Manuals
1 ³	Record drawings

¹One USB flash drive containing the electronic source file shall be included

²Unless otherwise required in the specific Section where requested.

³One marked-up set of Drawings (Original Markup).

1.02 SUBMITTAL PROCEDURES

- A. Transmit each submittal with a form acceptable to the ENGINEER, clearly identifying the project CONTRACTOR, the enclosed material and other pertinent information specified in other parts of this section. Identify variations from Contract Documents and Product or system limitations which may be detrimental to successful performance of the completed Work. Acceptance of submittals in electronic format via email attachment or USB flash drive shall be at the discretion of the CITY and ENGINEER. USB flash drives must be accompanied by the CONTRACTOR's transmittal stating the contents of the drive. Under no circumstances will hyperlinks to internet site(s) for submittal retrieval by the CITY or ENGINEER be accepted.
- B. Revise and resubmit submittals as required. Identify all changes made since previous submittals. Resubmittals shall be noted as such.
- C. Distribute copies of reviewed submittals to concerned parties. Instruct parties to promptly report any inability to comply with provisions.

1.03 CONSTRUCTION PROGRESS SCHEDULE

- A. The CONTRACTOR shall have the capability of preparing and utilizing the specified construction progress scheduling techniques. A statement of capability shall be submitted in writing to the ENGINEER with the return of the executed Agreement to the CITY and will verify that either the CONTRACTOR's organization has in-house capability qualified to use the technique or that the CONTRACTOR employs a consultant who is so qualified. Capability shall be verified by description of the construction projects to which the CONTRACTOR or its consultant has successfully applied the scheduling technique and which were controlled throughout the duration of the project by means of systematic use and updating of the construction progress schedule, the network analysis and associated reports. The submittal shall include the name of the individual on the CONTRACTOR's staff who will be responsible for the construction progress schedule, and associated reports and for providing the required updating information of same. The CONTRACTOR shall submit its proposed progress (baseline) schedule to the ENGINEER for review and comment within thirty days of the Notice to Award. The ENGINEER shall have the authority to determine acceptability/correctness of the schedule logic and activity interrelationships. The use of extraneous, nonworking activities and activities which add restraints to the construction schedule shall not be accepted. Baseline schedules that do not meet their contract completion dates shall not be accepted.
- B. The Contractor's progress schedule (baseline and monthly updates) shall be computer generated and resource loaded. Each construction progress schedule, and associated report shall include the following tabulations: a list of activities in numerical order, a list of activity precedence, schedules sequenced by Early Start Date, Total Float, and Late Start Date. Each schedule, and report shall include the following minimum items.
1. Activity Numbers
 2. Estimated Duration
 3. Activity Description
 4. Early Start Date (Calendar Dated)
 5. Early Finish Date (Calendar Dated)
 6. Latest Allowable Start Date (Calendar Dated)
 7. Latest Allowable Finish Date (Calendar Dated)
 8. Status (whether critical)
 9. Estimated Cost of the Activity
 10. Total Float and Free Float
- C. In addition, each construction progress schedule, network analysis and report shall be prefaced with the following summary data:

1. Contract Name and Number
 2. CONTRACTOR'S Name
 3. Contract Duration and Float
 4. Contract Schedule
 5. The Effective or Starting Date of the Schedule (the date indicated in the Notice-to-Proceed)
- D. The work day to calendar date correlation shall be based on an 8-hour day and 40-hour week with adequate allowance for holidays and all other special requirements of the Work. A total of five (5) days for adverse weather shall also be allowed for in the progress schedule such that the CONTRACTOR can secure the jobsite as specified in Section 01560.
- E. If the CONTRACTOR desires to make changes in its method of operating which affect the construction progress schedule and related items, the CONTRACTOR shall notify the ENGINEER in writing stating what changes are proposed and the reason for the change. If the ENGINEER accepts these changes, in writing, the CONTRACTOR shall revise and submit, without additional cost to the CITY, all of the affected portions of the construction progress schedule, and associated reports. The construction progress schedule and related items shall be adjusted by the CONTRACTOR only after prior acceptance, in writing by the ENGINEER. Adjustments may consist of changing portions of the activity sequence, activity durations, division of activities, or other adjustments as may be required. The addition of extraneous, nonworking activities and activities which add restraints to the construction progress schedule shall not be accepted.
- F. Except where earlier completions are specified, schedule dates which show completion of all Work prior to the contract completion date shall, in no event, be the basis for claim for delay against the CITY by the CONTRACTOR.
- G. Construction progress schedules and related items which contain activities showing negative float or which extend beyond the contract completion date will not be accepted by the ENGINEER.
- H. Whenever it becomes apparent from the current construction progress schedule and associated reports that delays to the critical path have resulted and the contract completion date will not be met, or when so directed by the ENGINEER, the CONTRACTOR shall take some or all of the following actions at no additional cost to the CITY. They shall submit to the ENGINEER for approval, a written statement of the steps they intend to take to remove or arrest the delay to the critical path in the current construction progress schedule, including a computer generated schedule revision to reflect proposed actions.
1. Increase construction manpower in such quantities and crafts as will substantially eliminate the backlog of work.

2. Increase the number of working hours per shift, shifts per day, working days per week, the amount of construction equipment, or any combination of the foregoing, sufficiently to substantially eliminate the backlog of work.
 3. Reschedule activities to achieve maximum practical concurrency of accomplishment of activities, and comply with the revised schedule.
- I. If when so requested by the ENGINEER, the CONTRACTOR should fail to submit a written statement of the steps they intend to take or should fail to take such steps as reviewed and accepted in writing by the ENGINEER, the ENGINEER may direct the CONTRACTOR to increase the level of effort in manpower (trades), equipment and work schedule (overtime, weekend and holiday work, etc.) to be employed by the CONTRACTOR in order to remove or arrest the delay to the critical path in the current construction progress schedule, and the CONTRACTOR shall promptly provide such level of effort at no additional cost to the CITY.
 - J. If the completion of any activity, whether or not critical, falls more than 100 percent behind its previously scheduled and accepted duration, the CONTRACTOR shall submit for approval a schedule adjustment showing each such activity divided into two activities reflecting completed versus uncompleted work.
 - K. Shop drawings which are not approved on the first submittal or within the time scheduled, and equipment which does not pass the specified tests and certifications shall be immediately rescheduled. The CONTRACTOR shall allow a 21 day review period for all shop drawings and other submittals requiring approval by the ENGINEER.
 - L. The contract time will be adjusted only in accordance with the General Requirements and other portions of the Contract Documents as may be applicable. If the ENGINEER finds that the CONTRACTOR is entitled to any extension of the contract completion date, the ENGINEER's determination as to the total number of days extension shall be based upon the current construction progress schedule and on all data relevant to the extension. Such data shall be included in the next updating of the schedule and related items. Actual delays in activities which, according to the construction progress schedule, do not affect any contract completion date will not be the basis for a change therein.
 - M. From time to time it may be necessary for the contract schedule of completion time to be adjusted by the CITY in accordance with the General Requirements and other portions of the Contract Documents as may be applicable. Under such conditions, the ENGINEER will direct the CONTRACTOR to reschedule the Work or contract completion time to reflect the changed conditions, and the CONTRACTOR shall revise the construction progress schedule and related items accordingly, at no additional cost to the CITY.
 - N. Available float time may be used by the CITY through the CITY'S ENGINEER.
 - O. The CITY controls the float time and, therefore, without obligation to extend either the overall completion date or any intermediate completion dates, the CITY may initiate changes that absorb float time only. CITY initiated changes that affect the critical path on the network diagram shall be the sole grounds for extending the completion dates. CONTRACTOR initiated changes that encroach on the float time may be accomplished

only with the CITY'S concurrence. Such changes, however, shall give way to CITY initiated changes competing for the same float time.

- P. To the extent that the construction project schedule, or associated report or any revision thereof shows anything not jointly agreed upon or fails to show anything jointly agreed upon, it shall not be deemed to have been accepted by the ENGINEER. Failure to include on a schedule any element of Work required for the performance of this Contract shall not excuse the CONTRACTOR from completing all Work required within any applicable completion date, notwithstanding the review of the schedule by the ENGINEER.
- Q. Review and acceptance of the construction progress schedule, and related reports, by the ENGINEER is advisory only and shall not relieve the CONTRACTOR of the responsibility for accomplishing the Work within the contract completion date. Omissions and errors in the construction progress schedule, and related reports shall not excuse performance less than that required by the Contract and in no way make the ENGINEER an insurer of the CONTRACTOR'S success or liable for time or cost overruns flowing from any shortcomings in the construction progress schedule, and related reports.
- R. The CONTRACTOR shall present and discuss the proposed schedule at the preconstruction conference.
- S. The construction progress schedule shall be based upon the precedence diagramming method of scheduling and shall be prepared in the form of a horizontal bar chart showing in detail the proposed sequence of the Work and identifying all construction activities included but not limited to yard piping, all structures and treatment units and all related Work specified herein to be performed under the Contract. The schedule shall be time scaled, identifying the first day of each week, with the estimated date of starting and completion of each stage of the Work in order to complete the project within the contract time. The project critical path shall be clearly identified in color or by other means acceptable to the ENGINEER.
- T. The progress schedule shall be plotted on 22-inch by 34-inch and 11-inch by 17-inch paper and shall be revised and updated monthly, depicting progress through the last day of the current month and scheduled progress through completion. Six (one 22-inch by 34-inch and five 11-inch by 17-inch), schedules, required schedule "sorts" (tabulations) and an electronic copy of the baseline schedule shall be submitted for review and acceptance. Six (one 22-inch by 34-inch and four 11-inch x 17-inch) up-to-date copies of the schedule and six copies of tabulations and an electronic copy shall be submitted along with the application for monthly progress payments for the same period.
- U. The construction progress schedule shall be developed and maintained using Primavera Sure Trak as manufactured by Primavera Systems, Inc., or equal.

1.04 SCHEDULE OF PAYMENT VALUES

- A. The CONTRACTOR shall submit a Schedule of Payment Values, in accordance with Section 01025, for all items in the proposal that are to be paid for on a lump sum basis. The schedule shall contain the labor and material values of the component parts of

Work for the purpose of making progress payments during the construction period. The Schedule of Payment Values shall directly correlate on an item by item basis (unless otherwise accepted by the ENGINEER) to each individual activity detailed in the construction progress schedule.

- B. The schedule shall be given in sufficient detail for the proper identification of Work accomplished. Each item shall include its proportional share of all costs including the CONTRACTOR's overhead, contingencies and profit. The sum of all scheduled items shall equal the total value of the Contract.
- C. If the CONTRACTOR anticipates the need for payment for materials stored on the project site, it shall also submit a separate list covering the cost of materials, delivered and unloaded with taxes paid. This list shall also include the installed value of the item with coded reference to the Work items in the Schedule of Payment Items.
- D. The CONTRACTOR shall expand or modify the above schedule and materials listing as required by the ENGINEER'S initial or subsequent reviews.
- E. The CONTRACTOR shall update the Schedule of Payment Values monthly for reviewing by the ENGINEER. The payment applications shall be reviewed by the ENGINEER in accordance with the updated Schedule of Payment Values.

1.05 SHOP DRAWINGS, PROJECT DATA AND SAMPLES

- A. General: A Shop Drawing Submittal Schedule shall be provided by the CONTRACTOR within thirty (30) days of the Notice to Proceed.
- B. The CONTRACTOR shall furnish for review ten (10) copies of shop drawings, project data, samples and other submittal items required by the Contract Documents. Three (3) copies shall be returned to the CONTRACTOR stamped "Furnish as Submitted" or "Furnish as Corrected". Where major corrections are indicated, two (2) copies will be returned stamped "Revise and Resubmit" and a new submittal is required (10 copies).
- C. The review of the CONTRACTOR'S submissions shall in no way relieve the CONTRACTOR of any of his responsibilities under the Contract. An acceptance of a submission shall be interpreted to mean that there are no specific objections to the submitted material, subject to conformance with the Contract Drawings and Specifications.
- D. All submissions shall be dated and properly referenced to the specifications section and Contract Drawing number. The submittal number shall match the following submittal numbering system (or an equivalent system as approved by the ENGINEER):

Submittal Numbering System

- 1. Package ID: The package number will reflect the CSI (specification) section number as it appears in the specifications.
- 2. Subgroup ID: The submittal number will include the CSI number followed by two additional codes. The first will define the type of submittal as follows:

- 01 Product Data, Specifications, Cut Sheets, Manufacturers certification or approval letters.
- 02 Shop Drawings
- 03 Product samples and mock-ups
- 04 Special requirements as required in the contract documents
- 05 As-Built Drawings
- 06 Warranties
- 07 O&M
- 08 Spare Parts

The second code will identify individual submittals within that submittal type. The number to the left of the decimal represents the submittal number and the number to the right of the decimal represents the revision number.

Example:

<u>Package</u>	<u>Submittal</u>	<u>Description</u>
03300	03300-01-1.1	Concrete Admixture A, First Submittal
06400	06400-01-1.2	Re-submittal
		First Submittal
		Product Data
		Finish Carpentry

By the following this code system, all submittals may be entered into the Document Tracking System prior to receipt of submittals. When a particular submittal is received, locate the entry in the Document Tracking project file, add the appropriate information and process. The Document Tracking System will provide the next sequence number.

- E. Shop Drawings and Project Data within practical limits shall be submitted as a single complete package for any operating system and shall include all items of equipment and mechanical units involved in the functioning of such system. Where applicable, the submission shall include elementary wiring diagrams showing circuit functioning and necessary interconnection wiring diagrams for construction.
- F. All submissions shall bear the CONTRACTOR'S stamp certifying that they have been checked for conformance and accuracy. Submissions without the CONTRACTOR'S

stamp of approval will not be reviewed by the ENGINEER and will be returned to the CONTRACTOR.

- G. For any submission containing any departure from the Contract Documents and the CONTRACTOR shall include proper explanation in his letter of submittal.
- H. Work on fabricated or special items shall not be commenced until the required submission information has been reviewed and accepted.
- I. Standard items shall not be assembled or shipped until the required submission information has been reviewed and accepted.
- J. Prior review actions shall not relieve the CONTRACTOR of the responsibility for correcting errors, deviations, and/or omissions discovered at a later date.
- K. Shop Drawings: Shop Drawings include, but are not limited to, layout drawings, installation drawings, construction drawings, certified and interconnecting wiring diagrams, etc. The CONTRACTOR shall be responsible for security of all the information, details, dimension, drawings, etc. necessary to prepare submission drawings required and necessary under this Contract and to fulfill all other requirements of his Contract. The CONTRACTOR shall secure such information, details, drawings, etc. from all possible sources including the Contract Drawings, drawings prepared by subcontractors, ENGINEER, manufacturers, CONTRACTORS, etc.
- L. Submission drawings shall accurately and clearly present the following:
 - 1. All working and installation dimensions.
 - 2. Arrangement and sectional views.
 - 3. Units of equipment in the proposed position for installation, details of required attachments and connections and dimensioned locations between units and in relation to the structures.
 - 4. Necessary details and information for making connections between the various trades including but not limited to, power supplies and interconnection wiring between units, accessories, appurtenances, etc.
- M. Product Data: Where manufacturer's publications in the form of catalogs, brochures, illustrations, or other data sheets are submitted in lieu of prepared shop drawings, such submission shall specifically indicate the particular item offered. Identification of such items and relative pertinent information shall be made with indelible ink. Submissions showing only general information will not be accepted.
- N. Product data shall include materials of construction, dimensions, performance characteristics, capacities, wiring diagrams, piping and controls, etc.
- O. Samples: CONTRACTOR shall furnish for review all samples as required by the Contract Documents or requested by the ENGINEER.

- P. Samples shall be of sufficient size or quantity to clearly illustrate the quality, type, range of color, finish or texture and shall be properly labeled to show the nature of the work where the material represented by the sample will be used.
- Q. Samples shall be checked by the CONTRACTOR for conformance to the Contract Documents before being submitted to the ENGINEER and shall bear the CONTRACTOR'S stamp certifying that they have been so checked. Transportation charges on samples submitted to the ENGINEER shall be prepaid by the CONTRACTOR.
- R. ENGINEER's review will be for compliance with the Contract Documents, and his comments will be transmitted to the CONTRACTOR with reasonable promptness.
- S. Accepted samples will establish the standards by which the completed work will be judged.

1.06 OPERATION AND MAINTENANCE INSTRUCTIONS (MANUALS)

- A. Individual Instructions: The CONTRACTOR , through manufacturer's representatives or other qualified individuals, shall provide instruction of designated employees of the CITY in the operation and care of all equipment furnished.
- B. Written Instructions: The CONTRACTOR shall furnish and deliver to the ENGINEER, prior to the fifty percent completion point of construction, and no later than thirty (30) days prior to operator training, ten (10) complete sets of instructions, technical bulletins, and any other printed matter such as diagrams, prints or drawings, containing full information required for the proper operation, maintenance, and repair of the equipment. As a minimum, the following shall be included in this submittal:
 - 1. Operating Instructions
 - 2. Troubleshooting Information
 - 3. Maintenance Schedule(s)
 - 4. Lubrication Schedule
 - 5. Location of Service Centers
 - 6. Parts Diagram and List
 - 7. Spare Parts List (spare parts furnished shall be defined)
 - 8. Special Tools List
 - 9. Installation Instructions
 - 10. Assembly & Erection Drawings
 - 11. Dimensional Drawings

12. Wiring Diagram(s)

13. Storage Instructions

- C. Availability of the O&M Manual is a prerequisite to the operation and acceptance of the system. Instructions shall be bound together in appropriate three-ring binders with a searchable electronic PDF provided, complete with Chapter bookmarks. A detailed Table of Contents shall be provided for each set. Written operation and maintenance instructions shall be required for all equipment items supplied. The amount of detail shall be commensurate with the complexity of the equipment item. They shall include all mechanical and electrical equipment such as valves, etc.
- D. Information not applicable to the specific piece of equipment installed on this project shall be struck from the submission. Information provided shall include a source of replacement parts and names of service representatives, including address and telephone number.

1.07 RECORD DRAWINGS

- A. The CONTRACTOR shall keep and maintain, at the job site, one record set of Drawings. On these, it shall mark all project conditions, locations, configurations, and any other changes or deviations which may vary from the details represented on the original Contract Drawings, including buried or concealed construction and utility features which are revealed during the course of construction. Special attention shall be given to recording the horizontal and vertical location of all buried utilities that differ from the locations indicated, or which were not indicated on the Drawings. As-Built furnished grade information shall be included on the record drawings. Said record drawings shall be supplemented by detailed sketches as necessary or directed to indicate, fully, the Work as actually constructed. These master record drawings of the CONTRACTOR'S representation of as-build conditions, including all revisions made necessary by addenda and change orders shall be maintained up-to-date during the progress of Work.
- B. The record drawings shall be received on the 20th working day of every third month after the month in which the final notice to proceed is given as well as on completion of Work. Failure to maintain the record drawings up-to-date shall be grounds of withholding monthly progress payments until such time as the record drawings are brought up-to-date.
- C. In the case of those drawings which depict the detail requirement for equipment to the assembled and wired in the factory, such as motor control centers and the like, the record drawing shall be updated by indicating those portions which are superseded by change order drawings or final shop drawings, and by including appropriate reference information describing the change orders by number and the shop drawings by manufacturer, drawing, and revision numbers.
- D. Record drawings shall be accessible to the ENGINEER at all times during the construction period.

- E. Final payment will not be acted upon until the CONTRACTOR prepared record drawings have been delivered to the ENGINEER. Said up-to-date record drawings shall be in the form of a set of prints with carefully plotted information overlaid in pencil.
- F. Upon substantial completion of the Work and prior to final acceptance, the CONTRACTOR shall finalize and deliver a complete set of record drawings to the ENGINEER for transmittal to the CITY, conforming to the construction records of the CONTRACTOR. This set of drawings shall consist of corrected drawings showing the reported location of the Work. The information submitted by the CONTRACTOR and incorporated in the Record Drawings will be assumed to be correct, and the ENGINEER will not be responsible for the accuracy of such information, and for any errors or omissions which may appear on the Record Drawings as a result.
- G. The information submitted by the CONTRACTOR in the record drawings shall be certified by a land surveyor registered in the State of Florida.
- H. The record drawings shall show the exact location of all structures and all mains within the right-of-way or easement, size and type of material of mains, all deflection points (vertical and horizontal), top pipe elevations and stationing at 100-foot increments, and exact dimensions and locations of all fittings and valves.

1.08 WARRANTIES

- A. Original warranties, called for in the Contract Documents, shall be submitted to the CITY through the ENGINEER. When warranties are required, they shall be submitted prior to request for payment.
- B. When advance copies of warranties are requested, they shall be submitted with, and considered as shop drawings.
- C. The CONTRACTOR shall warrant to the CITY that all material and labor used in the construction are covered by his warrantee for a minimum of a one year period upon approval and acceptance by the CITY. The CONTRACTOR shall replace or repair defects at no cost to the CITY during the warrantee period. No visible or potential leakage shall be allowed during the warrantee period.

1.09 CERTIFICATES

- A. Copies of certificates of compliance and test reports shall be submitted for requested items to the ENGINEER prior to request for payment.

1.10 AUDIO-VISUAL PRECONSTRUCTION RECORD

- A. General: Prior to commencing work, the CONTRACTOR shall have a continuous color audio-video digital video recording taken of the entire Project, including adjacent work areas, plant site and all other areas that will be disturbed by the Contractor's operations, to serve as a record of preconstruction conditions. No construction shall begin prior to review and acceptance of the discs covering the respective, affected construction area by the ENGINEER. The ENGINEER shall have the authority to reject all or any portion of the recording not conforming to the specifications and order that it be redone at no additional charge. The CONTRACTOR shall reschedule unacceptable

coverage within five days after being notified. The ENGINEER shall designate those areas, if any, to be omitted from or added to the audio-video coverage. Recordings shall not be performed more than ninety days prior to construction in any area. Recording format shall be MP4 audio-video, minimum 1280 x 720 resolution, and playable using Windows Media Player. CONTRACTOR shall submit MP4 video via three (3) flash drives. CDs and/or DVDs will not be accepted. All flash drives and written records shall become property of the City.

- B. Services: The CONTRACTOR shall engage the services of a professional electrographer. The color video shall be prepared by a responsible commercial firm known to be skilled and regularly engaged in the business of preconstruction color audio-video video documentation. The electrographer shall furnish to the ENGINEER a list of all equipment to be used for the audio-video recording, i.e., manufacturer's name, model number, specifications and other pertinent information. Additional information to be furnished by the electrographer is the names and addresses of two references that the electrographer has performed color audio-video recordings for on projects of a similar nature within the last twelve months.
- C. Equipment: All equipment, accessories, materials and labor to perform this service shall be furnished by the CONTRACTOR.
1. The total audio-video system shall reproduce bright, sharp, clear pictures with accurate colors and shall be free from distortion, tearing, rolls or any other form of imperfection. The audio portion of the recording shall reproduce the commentary of the camera operator with proper volume and clarity, and be free from distortion and interruptions.
 2. When conventional wheeled vehicles are used, the distance from the camera lens to the ground shall not be less than twelve feet. In some instances, audio-video coverage may be required in areas not accessible by conventional wheeled vehicles. Such coverage shall be obtained by walking or special conveyance acceptable to the ENGINEER.
 3. The color video camera used in the recording system shall have a horizontal resolution of 300 lines at center, a luminance signal to noise ratio of 45 dB and a minimum illumination requirement of twenty-five foot-candles.
- E. Recorded Information - Audio: Each disc shall begin with the current date, project name and municipality and be followed by the general location; i.e., process structure, or area, viewing side and direction of progress. The audio track shall consist of an original live recording. The recording shall contain the narrative commentary of the electrographer, recorded simultaneously with his fixed elevation video record of the zone of influence of construction.
- F. Recorded Information - Video: All video recordings must, by electronic means, display continuously and simultaneously, generated with the actual recording, transparent digital information to include the date and time of recording. The date information shall contain the month, day and year. The time information shall contain the hours, minutes, and seconds. Additional information shall be displayed periodically. Such information shall include, but not be limited to, project name, process structure or area, and the viewing

side. This transparent information shall appear on the extreme upper left hand third of the screen.

- G. Conditions for Recording: All recording shall be done during times of good visibility. No recording shall be done during precipitation, mist or fog. The recording shall only be done when sufficient sunlight is present to properly illuminate the subjects of recordings and to produce bright, sharp video recordings of those subjects.
- H. Video Coverage: Video coverage shall include all surface features located within the zone of influence of construction supported by appropriate audio coverage. Such coverage shall include, but not be limited to, existing driveways, sidewalks, curbs, pavement, landscaping, fences, signs and interior and exterior of existing structures affected by the work and the exteriors of structures adjacent to the work, and any other on-site area that will be occupied or impacted by the CONTRACTOR or any of his subcontractors or suppliers within the area covered.

1.11 PROJECT PHOTOGRAPHS

- A. The CONTRACTOR shall engage and pay for the services of a professional photographer for ground level progress pictures each month during the course of the construction activities. The photographer's periodic visits and work shall be coordinated with the CITY. A total of 12 progress photographs in electronic format of completed work is required each month. A photograph (picture) shall be defined as one exposure. Meta data shall include the following information:
 - 1. Name of Facility
 - 2. Name/number of Structure
 - 3. Photo Number
 - 4. Date picture was taken
 - 5. Description
 - 6. Name of photographer
 - 7. Owner's witness

PART 2 -- PRODUCTS (Not Used)

PART 3 -- EXECUTION (Not Used)

- END OF SECTION –

SECTION 01400 - TESTING AND INSPECTION

PART 1 -- GENERAL

- A. All testing and inspection will be in accordance with Article 12 of the General Conditions.
- B. The work or actions of the testing laboratory shall in no way relieve the CONTRACTOR of his obligations under the Contract. The laboratory testing work will include such inspections 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 or approve any of the CONTRACTOR'S work.
- C. The CONTRACTOR shall allow the ENGINEER ample time and opportunity for testing materials and equipment to be used in the work. He shall advise the ENGINEER promptly upon placing orders for materials and equipment so that arrangements may be made, if desired, for inspection before shipment from the place of manufacture. The CONTRACTOR shall at all times furnish the ENGINEER and his representatives, facilities including labor, and allow proper time for inspecting and testing materials, equipment, and workmanship. The CONTRACTOR must anticipate that possible delays may be caused him in the execution of his work due to the necessity of materials and equipment being inspected and accepted for use. The CONTRACTOR shall furnish, at his own expense, all samples of materials required by the ENGINEER for testing, and shall make his own arrangement for providing water, electric power, or fuel for the various inspections and tests of structures and equipment. As a minimum, 24-hours advance written notice shall be provided by the CONTRACTOR for rebar, structural and similar inspections by the ENGINEER. The amount of time required for advance written notice by the CONTRACTOR to the ENGINEER for other inspections depends upon other factors and shall be solely at the ENGINEER's discretion.
- D. 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 his 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 to the CITY the 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.
- E. The CITY will bear the cost of all additional tests, inspections, or investigations undertaken by the order of the ENGINEER for the purpose of determining conformance with the Contract Documents if such test, inspection, 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 test, inspections, or investigations, the CONTRACTOR shall bear the full cost thereof or shall reimburse the CITY for said cost. 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.

PART 2 -- PRODUCTS (Not Used)

PART 3 -- EXECUTION (Not Used)

- END OF SECTION -

SECTION 01500 - CONSTRUCTION CONSIDERATIONS

PART 1 -- GENERAL

1.01 HYDRAULIC UPLIFT ON STRUCTURES

- A. The CONTRACTOR shall be completely responsible for any tanks, wet wells, pipelines, manholes, foundations, cellars, or similar structures that may become buoyant during the construction operations due to the ground water, floods or buoyancy of piping caused due to the placement of flowable backfills before the structure is put into operation. Should there be any possibility of buoyancy of a pipeline or structure, the CONTRACTOR shall take the necessary steps to prevent its buoyancy. Damage to any structures due to floating or flooding shall be repaired or the structures replaced at the CONTRACTOR'S expense.

1.02 WATER TIGHTNESS OF STRUCTURES

- A. General: It is the intent of these specifications that all concrete work, sealing work around built-in items and penetrations be performed as required to ensure that groundwater, rainwater, wastewater, chemical solutions or other process liquids in tanks, wetwells, channels, and containers will not leak into any buildings and/or equipment rooms, pipe galleries, habitable areas, or other generally dry areas.
 - 1. The required watertightness shall be achieved by quality concrete construction and proper sealing of all joints and penetrations.
 - 2. Each unit shall be tested separately, and the leakage tests shall be made prior to backfilling and before equipment is installed unless otherwise approved by the ENGINEER.
 - 3. The CONTRACTOR shall provide at his own expense all labor, material, temporary bulkheads, pumps, water, measuring devices, etc., necessary to perform the required test.
- B. Built-in Items and Penetrations: All pipe sleeves, built-in items and penetrations shall be sealed as detailed and as required to ensure a continuous watertight seal.

1.03 CUTTING AND PATCHING

- A. The CONTRACTOR shall perform all cutting and patching of his work that may be required to make its several parts come together properly and fit it to receive or be received by such other work. The CONTRACTOR shall not endanger any work of others by cutting, excavating or otherwise altering their work and shall only cut or alter work with the written consent of the ENGINEER and of the other contractors whose work will be affected.

1.04 ABANDONMENT AND SALVAGE OF EXISTING FACILITIES

- A. General: The scope of work requires the CONTRACTOR to interface with existing structures, and piping which will be abandoned or otherwise removed and/or relocated

as part of the work. Prior to beginning any work associated with existing facilities to be abandoned, salvaged, or otherwise removed or relocated, the CONTRACTOR shall inform the CITY and the ENGINEER of his intent so that all arrangements can be made with the CITY for isolating pipelines (where possible) or otherwise removing existing facilities from service to the extent possible. The CONTRACTOR shall not proceed without written authorization from the CITY.

- B. Pipelines: The CONTRACTOR shall abandon, salvage or otherwise remove existing pipelines or segments of existing pipelines shown to be abandoned in place, salvaged, or removed as part of the contract work. Unless otherwise indicated in the Contract Documents, all piping shown on the Drawings to be abandoned shall be abandoned in place. Pipe shown to be abandoned need only be removed a minimum three feet clear of new utilities to be installed. Abandon-in-place shall be defined as installing plugs, or other permanent closure, as reviewed and accepted by the CITY, on all termination's, open ends or ends of pipe designated as being cut, capped and anchored in an acceptable manner. The pipe will remain buried unless otherwise noted.
- C. Piping indicated on the Drawings as being removed, or any piping to be abandoned which interferes with new structures or piping, shall be excavated and removed using methods which will not disturb adjacent piping or other facilities. All pipe materials shall be subject to salvage by the CITY as defined below. Any remaining piping on both ends of pipe segments removed shall be abandoned in-place, per the above definition. After piping has been removed, the CONTRACTOR shall backfill the excavated area in accordance with requirements set forth in other sections of these specifications.
- D. Equipment: The CONTRACTOR shall abandon, salvage or otherwise remove existing equipment or other facilities as shown on the Contract Drawings or indicated herein. In all cases, the CONTRACTOR shall exercise caution when handling the existing equipment so as not to disturb or damage adjacent facilities. The CONTRACTOR shall make all repairs to adjacent facilities which may be damaged as a result of the CONTRACTOR's efforts in abandoning, salvaging or otherwise removing existing facilities, at no additional cost to the CITY.
- E. Salvage: The CITY may desire to salvage certain items of existing equipment which are to be dismantled and removed during the course of construction. Prior to removal of any existing equipment or piping from the site of work, the CONTRACTOR shall ascertain from the CITY whether or not the particular item or items are to be salvaged. Items to be salvaged shall be stockpiled on the site, in a location as designated by the CITY. All other items of equipment shall be disposed of off-site by the CONTRACTOR at his own expense, in accordance with applicable laws, ordinances and regulations.

1.05 DIMENSIONS OF EXISTING STRUCTURES

- A. Where the dimensions and locations of existing structures are of critical importance in the installation or connection of new work, the CONTRACTOR shall verify such dimensions and locations in the field before the fabrication of any materials or equipment which is dependent on the correctness of such information.

1.06 REHABILITATION

- A. Certain areas of existing structures, piping, conduits, and the like will be affected by work necessary to complete modifications under this Contract. The CONTRACTOR shall be responsible to rehabilitate those areas affected by its construction activities.
- B. Where new rectangular openings are to be installed in concrete or concrete masonry walls or floors, the CONTRACTOR shall score the edges of each opening (both sides of wall or elevated slab) by saw cutting clean straight lines to a minimum depth of one inch and then chipping out the concrete. Alternately, the opening can be formed by saw cutting completely through the slab or wall. Saw cuts deeper than one inch (or the depth of cover over existing reinforcing steel, whichever is less) shall not be allowed to extend beyond the limits of the opening. Corners shall be made square and true by a combination of core drilling, chipping, or grinding. All necessary precautions shall be taken during removal of concrete to prevent debris from falling and damaging adjacent equipment or piping. Saw cuts allowed to extend beyond the opening shall be repaired by filling with nonshrink grout. The concrete around any exposed reinforcement steel shall be chipped back and exposed reinforcement steel cut a minimum of 1-1/2 inches from the finished face of the new opening. The inside face of the new opening shall be grout to fill any voids and cover the exposed aggregate and shall be trowel-finished to provide a plumb and square opening.
- C. Where new piping is to be connected to existing piping, the existing piping shall be cut square and the ends properly prepared for the connection shown on the drawings. Any damage to the lining and coating of the existing piping shall be repaired by the CONTRACTOR.
- D. Where existing equipment, equipment pads and bases, piping, piping supports, electrical panels and devices, conduits, and associated appurtenances are removed, the CONTRACTOR shall rehabilitate the affected area such that little or no evidence of the previous installation remains. Opening in concrete floors, walls, and ceiling from piping, conduit, and fastener penetrations shall be filled with nonshrink grout and finished to match the adjacent area. Concrete pads and bases for equipment and supports shall be removed by chipping away concrete and cutting any exposed reinforced steel and anchor bolts a minimum of 1-1/2 inches below finished grade. The area of concrete to be rehabilitated shall be scored by saw cutting clean, straight lines to a minimum depth of 1-1/2 inches, and all concrete within the scored lines removed to a minimum depth of 1-1/2 inches. The area within the scored lines shall be patched with nonshrink grout to match the adjacent grade and finish. Abandoned connections to piping and conduits shall be terminated with blind flanges, caps, and plugs suited for the material, type, and service of the pipe or conduit.
- E. Where existing structural steel members are removed or modified, the surface of the remaining existing steel members damaged by construction activities shall be repaired. The affected areas shall be surface prepared and coated in accordance with Division 9.
- F. Disposal of Debris: All debris, materials, piping, and miscellaneous waste products from the work described in this section shall be removed from the project as soon as possible. They shall be disposed of in accordance with applicable federal, state, and

local regulations. The CONTRACTOR is responsible for determining these regulations and shall bear all costs or retain any profit associated with disposal of these items.

1.07 INSTALLATION OF EQUIPMENT

- A. CONTRACTOR shall have on hand sufficient personnel, proper equipment, and machinery of ample capacity to facilitate the work.
- B. CONTRACTOR shall be responsible for locating, aligning and leveling all equipment and shall employ a licensed surveyor to set all lines and levels of equipment to the accuracy required.
- C. Complete manufacturers installation instructions, including permissible tolerances, shall be furnished in duplicate with each unit of equipment or set of identical units.
- D. All equipment shall be installed in accordance with the shop drawings; inclusive of manufacturer's specifications, drawings and tolerances; under the direct supervision of the required manufacturer's ENGINEER. No instructions shall be issued that are contrary to written specifications without prior written approval by the CITY's ENGINEER.
- E. Equipment shall be erected in a neat and workmanlike manner on the foundations at the locations and elevations shown on the drawings unless otherwise indicated by the ENGINEER during installation.

1.08 SUPERVISION BY MANUFACTURER'S REPRESENTATIVES

- A. The CONTRACTOR shall provide the services of qualified equipment manufacturer's technical representatives who shall adequately supervise the installation and testing of all equipment furnished under this Contract and instruct the CONTRACTOR's personnel and CITY's operating personnel in its maintenance and operation.

1.09 EQUIPMENT MANUFACTURER'S CERTIFICATION

- A. As a condition precedent to acceptance of equipment installed and operating, the CONTRACTOR will provide the CITY with written certification, obtained from each company manufacturing equipment for the Project, that the equipment is installed and does operate in accordance with the specifications and manufacturer's recommendations.

1.10 SLEEVES AND OPENINGS

- A. The CONTRACTOR shall provide all openings, chases, etc., to fit his own work and that of any other subcontractors and contractors. All such openings or chases shown on the Contract Drawings, or reasonably implied thereby, or as confirmed or modified by shop, setting or erecting drawings approved by the ENGINEER, shall be provided by the CONTRACTOR.
- B. Where pipes or conduits are to pass through slabs or walls, or where equipment frames or supports are to be installed as integral part of an opening, the sleeves, opening,

forms or frames shall be furnished by the installer of the pipes, conduits or equipment, but shall be placed by the CONTRACTOR.

- C. Where hanger inserts, anchor bolts and similar items are to be embedded in concrete as an integral part of a slab or wall, they shall be furnished by the installer of the pipe or other equipment requiring the hanger, etc. but shall be placed by the CONTRACTOR.
- D. When requested by the CONTRACTOR, the installer of the pipes, conduit, or equipment, including those contractors or subcontractors who require openings or chases in slabs and walls for passage of ducts, mounting or equipment, etc., shall furnish all necessary information, instructions, and materials to effect accurate installation of the required openings, chases, sleeves, frames, inserts, etc. When such items are secured in position, and just prior to construction of the surrounding slab or wall, the subcontractor or contractor for whom the items are installed shall ascertain the proper number, locations, and settings thereof; and the CONTRACTOR shall schedule his operations so as to provide a reasonable opportunity and time interval for such inspection.
- E. Any cost resulting from correction of defective, ill-timed, or mislocated work, or for subsequent work which becomes necessary because of omitted openings, chases, sleeves, frames, inserts, etc., shall be borne by the subcontractor or contractor responsible therefor. No contractor or subcontractor shall arbitrarily cut, drill, alter, damage, or otherwise endanger the work of another Contractor. In no case shall beams lintels, or other structural members be cut without the approval of the ENGINEER. The nature and extent of any corrective or additional work shall be subject to the approval of the ENGINEER following consultation with the affected parties.

1.11 OBSTRUCTIONS

- A. All water pipes, storm drains, sanitary sewers, force mains, gas or other pipe, telephone or power cables or conduits and all other obstructions, whether or not shown, shall be temporarily supported across utility line excavations. The CONTRACTOR shall be responsible for any damage to any such pipes, conduits, or structures. Approximate locations of known water, sanitary, drainage, power and telephone installations along route of new pipelines or in the vicinity of new work are shown, but must be verified in the field by the CONTRACTOR. The CONTRACTOR shall uncover these pipes, ducts, cables, etc., carefully, by hand, prior to installing new lines. Any discrepancies or differences found shall be brought to the attention of the ENGINEER in order that necessary changes may be made to permit installation of new work. These conditions are supplemental to general requirements elsewhere in the Contract Documents.

1.12 SITE CONDITIONS

- A. The CONTRACTOR acknowledges that he has investigated prior to bidding and satisfied himself as to the conditions affecting the Work, including but not restricted to those bearing upon transportation, disposal, handling and storage of materials, availability of labor, water, electric power, roads and uncertainties of weather, canal stages, tides, water tables or similar physical conditions at the site, the conformation and conditions of the ground, the character of equipment and facilities needed preliminary to and during prosecution of the Work. The CONTRACTOR further

acknowledges that he has satisfied himself as to the character, quality and quantity of surface and subsurface materials or obstacles to be encountered insofar as this information is reasonably ascertainable from an inspection of the site, or any contiguous site, as well as from information presented by the Drawings and Specifications made a part of this Contract, or any other information made available to him prior to receipt of Bids. Any failure by the CONTRACTOR to acquaint himself with the available information will not relieve him from responsibility for estimating properly the difficulty or cost of successfully performing the Work. The CITY assumes no responsibility for any conclusions or interpretations made by the CONTRACTOR on the basis of the information made available by the CITY.

1.13 SUBSURFACE INVESTIGATIONS

- A. The CONTRACTOR shall be responsible for having determined to his satisfaction, prior to the submission of his bid, the nature and location of the work, the conformation of the ground, the character and quality of the substrata, the types and quantity of materials to be encountered, the nature of the groundwater condition, the character of equipment and facilities required preliminary to and during the performance of the work, the general and local conditions and all other matters which can in any way affect the work under this Contract. The prices established for the work to be done shall reflect all costs pertaining to the work. Any claims for extras based on the substrata or ground water table conditions will be disallowed.
- B. Subsurface data are offered in good faith solely for placing the CONTRACTOR in receipt of all information available to the CITY and ENGINEER and in no event is to be considered as part of the Contract Documents. The CONTRACTOR shall interpret such sub-surface data according to his own judgment and not rely upon the same as accurately describing the sub-surface conditions, which may be found to exist.
- C. The CONTRACTOR further acknowledges that he assumes all risk contingent upon the nature of the subsurface conditions actually encountered by him in performing the work covered by the Contract, even though such actual conditions may result in the CONTRACTOR performing more or less work than he originally anticipated.
- D. In making these data available, the CITY makes no guarantee, either expressed or implied, as to their accuracy or to the accuracy of any interpretation thereof.

1.14 DIFFERING SITE CONDITIONS

- A. The CONTRACTOR shall promptly and before such conditions are disturbed, notify the CITY in writing of: (1) subsurface or latent physical conditions at the site differing materially from those indicated in this contract, or (2) unknown physical conditions at the site, of an unusual nature, differing materially from those ordinarily encountered and generally recognized as inherent in work of the character provided for this contract. The CITY will promptly investigate the conditions, and if he finds that such conditions do materially so differ and cause an increase or decrease in the CONTRACTOR's cost of, or the time required for, performance of any part of the work under this contract, whether or not changed as a result of such conditions, an equitable adjustment shall be made and the contract modified in writing accordingly

1.15 PROTECTION OF PROPERTY

- A. The CONTRACTOR shall protect all property that may be affected by his work or operations. The location and extent of underground and covered facilities are not guaranteed and the CONTRACTOR is cautioned to proceed with care in order to prevent the undermining or damage to existing structures, piping, or facilities.
- B. The CONTRACTOR shall take all measures necessary to protect new and existing mechanical equipment from dust and debris. All protective measures shall be furnished, installed, lighted, ventilated, maintained, and removed at the CONTRACTOR'S own cost.
- C. When CITY water is being used, the supply source shall be protected against contamination in accordance with existing codes and regulations.
- D. In the event any of the CONTRACTOR'S activities were to disrupt or endanger any facilities, he shall at his own expense make all necessary repairs or replacements necessary to correct the situation to the satisfaction of the ENGINEER. Such work shall progress continuously to completion on a 24-hour per day, seven workday basis. The CONTRACTOR shall be responsible for the services of repair crews on call 24 hours per day for emergencies that arise involving work under this Contract.

1.16 WEATHER CONDITIONS

- A. Work that may be affected by inclement weather shall be suspended until proper conditions prevail. In the event of impending storms the CONTRACTOR shall take necessary precautions to protect all work, materials and equipment from exposure. The CITY reserves the right, through the opinion of the ENGINEER, to order that additional protection measures over and beyond those proposed by the CONTRACTOR, be taken to safeguard all components of the project. The CONTRACTOR shall not claim any compensation for such precautionary measures so ordered, nor claim any compensation from the CITY for damage to the work from the elements of weather.

1.17 FIRE PROTECTION

- A. The CONTRACTOR shall take all necessary precautions to prevent fires at or adjacent to the work, including his own buildings and trailers. Adequate fire extinguisher and hose line stations shall be provided throughout the work area.

1.18 SAFETY AND HEALTH REQUIREMENTS

- A. The CONTRACTOR shall comply in every respect with all Federal, State and local safety and health regulations. Copies of the Federal Regulations may be obtained from the U.S. Department of Labor, Occupational Safety and Health Administration, 3200 East Oakland Park Boulevard, Room 204, Bridge Building, Fort Lauderdale, Florida 33300.
- B. The CONTRACTOR shall provide all barricades and flashing warning lights or other devices necessary to warn pedestrians and area traffic.

- C. Personnel working in contact with sewage flow or surfaces carrying wastewaters or sludges shall be immunized as recommended by the Broward County Health Department.

PART 2 -- PRODUCTS (Not Used)

PART 3 -- EXECUTION (Not Used)

- END OF SECTION -

SECTION 01510 - TEMPORARY UTILITIES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The CONTRACTOR shall provide temporary telephone, light and power, heating and air conditioning, potable water service and sanitary facilities for their operations and for the construction operations of the other subcontractors of this Project at the site. The temporary services shall be provided for use throughout the construction period.
- B. The CONTRACTOR shall coordinate and install all temporary services in accordance with the requirements of the utility companies having jurisdiction and as required by applicable codes and regulations.
- C. At the completion of the work, or when the temporary services are no longer required, the facilities shall be restored to their original conditions.
- D. All costs in connection with the temporary services including, but not limited to, installation, utility company service charges, maintenance, relocation and removal shall be borne by the CONTRACTOR at no additional cost to the CITY.
- E. Some temporary facilities that may be required may be indicated on the Drawings; however, the Drawings do not necessarily show any or all of the temporary facilities that the CONTRACTOR ultimately uses to complete the work.
- F. Temporary Light and Power
 - 1. The temporary general lighting and small power requirements shall be serviced by 120/240 V, 1 phase, 3 wire temporary systems furnished and installed by the CONTRACTOR. This service shall be furnished complete with step down transformer, main disconnect, overcurrent protection, branch circuit breakers, and wiring as required; including branch circuit breakers and wiring as required for furnishing temporary power to the various connections required by the CONTRACTOR, all in accordance with the requirements of the servicing power company and applicable standards and codes. Connection to the plant emergency power system is prohibited. CITY shall not be responsible for CONTRACTOR loss of power in the event of a power interruption caused by the power company or any other event which may cause an interruption in service to the temporary light and power system. Any CONTRACTOR with a need for power other than the 120/240 V, 1 phase, 3 wire shall provide such power at their own expense.
 - 2. The CONTRACTOR shall make all necessary arrangements, and pay for all permits, inspections, and other charges for all temporary service installations. All temporary systems shall comply with and meet the approval of the ENGINEER, CITY and the local authorities having jurisdiction. All temporary electrical systems shall consist of wiring, switches, necessary insulated supports, poles, fixtures, sockets, receptacles, lamps, guards, cutouts, and fuses as required to complete such installations. The CONTRACTOR shall furnish lamps and fuses for all temporary systems furnished by

him and shall replace broken and burned out lamps, blown fuses, damaged wiring and as required to maintain these systems in adequate and safe operating condition. All such temporary light and power system shall be installed without interfering with the work of the other CONTRACTORS.

When it is necessary during the progress of construction that a temporary electrical facility installed under this Division interferes with construction operations, the CONTRACTOR shall relocate the temporary electrical facilities to maintain temporary power as required at no additional cost to the CITY. The CONTRACTOR shall be responsible at all times for any damage or injury to equipment, materials, or personnel caused by improperly protected or installed temporary installations and equipment.

3. The various CONTRACTORS doing the work at the site shall be permitted to connect into the temporary general lighting system small hand tools, such as drills, hammers, and grinders, provided that:
 - a. Equipment and tools are suitable for 120 V, single phase, 60 Hz operation and operating input does not exceed 1,500 volt-amperes.
 - b. Tools are connected to outlets of the system with only one (1) unit connected to a single outlet.
 - c. In case of overloading of circuits, the CONTRACTOR will restrict use of equipment and tools as required for correct loading.
4. The CONTRACTOR shall keep the temporary general lighting systems energized 15 minutes before the time that the earliest trade starts in the morning and de-energized 15 minutes after the time the latest trade stops. This applies to all weekdays, Monday through Friday, inclusive, which are established as regular working days.

Any CONTRACTOR requiring temporary light and power before or after the hours set forth hereinbefore, or on a Saturday, Sunday, or holiday, shall pay for the additional cost of keeping the system energized and repaired. If more than one CONTRACTOR is involved, the charges shall be prorated, such amounts to be determined from the meter readings or other acceptable means previously agreed upon by the CONTRACTORS involved. If it is necessary for any CONTRACTOR or his employees to be in any structure after regular working hours and the temporary general lighting system is not required for illumination, that CONTRACTOR shall provide such illumination required by means of flashlights, electric lanterns, or other devices not requiring use of electricity from the temporary general lighting system.

5. Each CONTRACTOR requiring additional power and lighting other than that specified herein (including power for temporary heating equipment to be provided by the CONTRACTOR) shall furnish his own service complete with all fuses, cutouts, wiring and other material and equipment necessary for a complete system between the service point and the additional power consumers and shall install his own metering equipment in accordance with the requirements of the servicing power company.

6. The temporary general lighting system shall be installed progressively in structures as the various areas are enclosed or as lighting becomes necessary because of partial enclosure. Lighting intensities shall be not less than 10 foot candles.
7. The CONTRACTOR shall provide a separate temporary night lighting circuit for construction security. This system shall be energized at the end of each normal working day and de-energized at the start of each normal working day by the CONTRACTOR. The system is to be left energized over Saturdays, Sundays, and all holidays. Lighting intensities shall be not less than 2 foot candles.
8. Electrical welders provided by each trade used in the erection and fabrication of the buildings, structures and equipment shall be provided with an independent grounding cable connected directly to the structure on which the weld is being made rather than adjacent conduit piping, etc.

Electricians and other tradesmen necessary for the required connections and operation of welding equipment and generator, standby generators and similar equipment shall be furnished by the individual CONTRACTORS. All costs for such labor and equipment shall be borne by the individual CONTRACTORS.

9. Upon completion of the work, but prior to acceptance by the CITY, the CONTRACTOR shall remove all temporary services, security lighting systems, temporary general lighting systems and all temporary electrical work from the premises.

G. Temporary Heating and Air Conditioning

1. The CONTRACTOR shall provide temporary heating, air conditioning, ventilation coverings and enclosures necessary to properly protect all work and materials against damage by dampness, heat and/or cold, to dry out the work and to facilitate work in all structures.
2. The equipment, fuel, materials, operating personnel and methods used shall be at all times satisfactory and adequate to maintain critical installation temperatures and ventilation for all work in those areas where the same is required.
3. After any structure is enclosed, the minimum temperature to be maintained is 50 degrees Fahrenheit, unless otherwise specified, where work is actually being performed.
4. Before and during the application of interior finishing, painting, etc., the CONTRACTOR shall provide sufficient heat to maintain a temperature of not less than 65 degrees Fahrenheit or greater than 85 degrees Fahrenheit.
5. Any work damaged by dampness or insufficient or abnormal heating shall be replaced by the CONTRACTOR at no additional cost to the CITY.

H. Temporary Sanitary Service

1. Sanitary conveniences, in sufficient numbers, for the use of all persons employed on the work and properly screened from public observation, shall be provided and

maintained at suitable locations by the CONTRACTOR, all as prescribed by State Labor Regulations and local ordinances. The contents of same shall be removed and disposed of in a manner consistent with local and state regulations, as the occasion requires. Each CONTRACTOR shall rigorously prohibit the committing of nuisances within, on, or about the work. Sanitary facilities shall be removed from the site when no longer required.

I. Temporary Water

1. The CONTRACTOR shall provide temporary potable water service for construction purposes, sanitary facilities, fire protection, field offices and for cleaning. The CONTRACTOR shall make all arrangements for connections to the potable water at the plant site. The CONTRACTOR shall obtain a potable water flowmeter from the Department of Public Utilities at the CITY of Hollywood.
2. The CONTRACTOR shall pay all charges associated with the potable water connection. The CONTRACTOR shall pay all charges for potable water used under this Contract.
3. Each CONTRACTOR shall supply potable water for his employees either by portable containers or drinking fountains.
4. An adequate number of hose bibbs, hoses, and watertight barrels shall be provided for the distribution of water.
5. Water service shall be extended by the CONTRACTOR and relocated as necessary to meet temporary water requirements.

J. Confined Spaces

1. The CONTRACTOR shall provide and maintain a safe working environment in confined spaces. The CONTRACTOR shall follow the applicable requirements of the OSHA Standards for Construction and NIOSH Publications for working in confined spaces.

PART 2 -- PRODUCTS (Not Used)

PART 3 -- EXECUTION (Not Used)

- END OF SECTION -

SECTION 01520 - MAINTENANCE OF FACILITIES AND SEQUENCE OF CONSTRUCTION

PART 1 -- GENERAL

1.01 GENERAL

- A. The City of Hollywood's Southern Regional Wastewater Treatment Plant will be maintained in continuous operation during the entire period of the Contract as hereinafter specified. Portions of RAS Pump Station No. 1 will be removed from service as specified herein. The intent of this specification is to outline the requirements to provide continuous treatment throughout the construction period.
- B. The CONTRACTOR has the option of providing additional temporary facilities that can eliminate a constraint, provided it is done without cost to the CITY (including additional CITY labor) and provided that all requirements of these Specifications are fulfilled. Work not specifically covered in the following paragraphs may, in general, be done at any time during the contract period, subject to the operating requirements and constraints and construction requirements outlined hereinafter. All references to days in this Section shall be consecutive calendar days.

1.02 CONSTRUCTION SCHEDULE

- A. The construction schedule shall be submitted by the CONTRACTOR in accordance with Section 01300 of these Specifications.

1.03 USE OF FACILITIES BEFORE COMPLETION

- A. The CITY reserves the right to enter and use any portion of the constructed facilities before final completion of the whole work to be done under this Contract in accordance with Article 14.2 Partial Utilization, of the General Conditions.

1.04 CONNECTION OF EXISTING SYSTEMS

- A. All connections to existing systems shall be performed in such a manner that no damage and minimal interruption is caused to the existing installation. On completion of its installation, the CONTRACTOR shall complete the connection to the existing systems in a proper manner. Any damage caused to existing installations shall be repaired or replaced by the CONTRACTOR at no additional cost to the CITY.
- B. The CONTRACTOR shall note that some of the work in this Contract will require the CONTRACTOR to connect to existing pipelines and structures. The CONTRACTOR shall be responsible for the proper containment and disposal of wastewater or other materials drained from existing pipelines and structures during construction, unless otherwise specifically noted to be performed by the CITY.
- C. The CONTRACTOR shall contain such wastewater or other materials (in accordance with all applicable codes) and shall dispose of such within the existing treatment system as approved by the CITY. The CONTRACTOR shall be responsible for the prevention of wastewater or other material spills within the Work.

1.05 COORDINATION WITH UTILITY PERSONNEL

- A. Before commencing work involving removing or placing in operation existing or new facilities or tie-ins to existing facilities, the CONTRACTOR shall notify the CITY at least ten (10) days in advance in writing. The CITY shall be responsible for removing facilities from operation as deemed necessary.
- B. Only the CITY's appointed representative can authorize the shutdown of portions of the treatment plant facilities. The CONTRACTOR shall, under no circumstances, interfere with any treatment plant facility component without the CITY's authorization, in writing, and supervision. The CONTRACTOR shall notify the CITY's representative in writing a minimum of three work days prior to each scheduled service request. This notification shall be provided on the CITY's standard form, or on an approved equivalent form completed in full by the CONTRACTOR.

1.06 GENERAL CONSTRAINTS

- A. Work under the Contract shall be scheduled and performed in such a manner as to result in the least possible disruption to the operation of the treatment plant facilities and to the public's use of roadways, driveways, parking areas, and utilities. Utilities shall include but not be limited to water, sewerage, irrigation, drainage structures, gas, electrical service and telephone. Prior to commencing with the work, CONTRACTOR shall perform a location investigation of existing underground utilities and facilities in accordance with Section 01530 entitled "Protection of Existing Facilities".
- B. All work by the CONTRACTOR that disrupts the normal treatment plant operations shall be shown on the Construction Schedule specified in Section 01300 and specifically scheduled with the CITY. Schedule notification shall consist of a written notice defining the work to be accomplished, the normal functions that will be interrupted, the duration of the interruption, and the mitigating effort to be performed by the CONTRACTOR. The written notice shall be submitted to the CITY ten (10) days in advance of the proposed work and the CITY will respond to the CONTRACTOR in writing within five (5) days of receipt of the notice regarding the acceptability of the proposed plan.
- C. At no time shall the CONTRACTOR undertake to close off any pipelines, or open any valves, or take any other action which would affect the operation of the existing system, except as specifically required by the drawings and specifications, until authorization is granted by the CITY and after proper notification.
- D. Temporary installations required to complete a particular aspect of the work during the allotted time period shall be determined by the CONTRACTOR and implemented by the CONTRACTOR at no additional cost to the CITY. All such temporary installations shall be subject to the review and acceptance of the CITY.
- E. Sequence of certain major events and identification of time constraints for removing existing facilities from active service and installation of new facilities are described below. No phase of work (or tasks within a phase) shall preclude or be performed in parallel with a subsequent phase unless specifically defined so in these documents. In all cases, work in each phase shall be checked out and accepted for satisfactory use, subject to the CITY's approval, prior to the CONTRACTOR proceeding to the next phase of construction.

- F. 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 CITY'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.
- G. Wastewater Dewatering: The CONTRACTOR shall note that wastewater dewatering of existing pipelines and structures is required. The CONTRACTOR shall be responsible for the proper containment and disposal of wastewater, chemicals, etc. drained from existing pipelines and structures during construction. The CONTRACTOR shall contain such wastewater, chemical, etc. in accordance with all applicable codes and shall dispose of such to an on-site wastewater basin as designated by the CITY. The CONTRACTOR shall be responsible for the prevention of wastewater, chemicals, etc. spills within the work area. Refer to Division 2 for additional requirements and related requirements for construction dewatering.
- H. Cancellation of Planned Shutdown: A planned shutdown in accordance with the Contract Documents may be canceled by the CITY upon 24 hour notification by the CITY to the CONTRACTOR. Cancellations shall be expected due to wet weather conditions or other conditions beyond control of the CITY or CONTRACTOR. All efforts shall be made by the CONTRACTOR to check weather forecasts and the like prior to scheduling shutdowns. The CITY shall not be responsible for any additional costs associated with the cancellation of a planned shutdown.
- I. Treatment Plant Access: CONTRACTOR shall maintain access for plant personnel to all treatment plant unit processes at all times. If demolition, construction, or rehabilitation activities impede or obstruct access to any unit process, CONTRACTOR shall provide a temporary means for access.

1.07 OVERALL SEQUENCE OF CONSTRUCTION

A. Mobilization/Site Preparation:

1. Mobilize for work – Set up staging area as per Drawings, obtain any permits required, develop and submit construction schedule, submit shop drawing schedule and begin shop drawing submittals and procurement of materials.
2. For interfering utilities, construct new utilities up to tie-in points, perform tests, and then make final connections with minimum amount of shutdown time. After acceptance of new utilities, remove existing interfering underground utilities and structures. Provide temporary services as required to maintain continuous site drainage, plant treatment and operation, (water, control and electrical lines), etc.

B. Demolition, Rehabilitation and Construction of New Facilities:

1. CONTRACTOR shall complete all demolition, construction and rehabilitation work described in the Contract Documents.
2. CONTRACTOR shall complete all startup, testing and training activities required by the Contract Documents.
3. CONTRACTOR shall complete site restoration, site cleanup and demobilization activities.

C. Project Closeout:

1. CONTRACTOR shall complete all final punch list items.
2. CONTRACTOR shall complete project closeout in accordance with Section 01700.
3. Final acceptance of project.
4. Commence warranty period.

1.08 DETAILED SEQUENCE OF CONSTRUCTION AND OPERATIONAL CONSTRAINTS

A. Oxygenation Train Nos. 1 and 2 Patch and Leak Repair

1. General Requirements:
 - a. The CONTRACTOR shall notify the CITY in writing ten days in advance of any work done to the Oxygenation tanks.
2. Detailed Sequence of Construction:
 - a. Complete all repair work on Oxygenation Trains 1 and 2.

B. RAS Pump Station Nos. 2, 3, and 4 – RAS Valve Actuator Retrofit

1. General Requirements:
 - a. The CONTRACTOR shall notify the CITY in writing ten days in advance of any work done at the valves / pump stations.
2. Detailed Sequence of Construction:
 - a. Complete all work related to valve actuator retrofit.

C. RAS Pump Station No. 1 – WAS Piping Modifications

1. General Requirements:
 - a. The CONTRACTOR shall notify the CITY in writing ten days in advance

of any work done to the WAS Piping.

- b. The CONTRACTOR shall be responsible for draining and dewatering the existing lines as required to complete work. The CONTRACTOR is responsible for disposal of contents of the line.
- c. The WAS pipe is limited to one shut down of two weeks in duration to perform the required work. Shutdown shall be simultaneous with shutdown of Clarifier Nos. 1 and 2.

2. Detailed Sequence of Construction for Work for WAS Piping Modifications

- a. Coordinate with CITY to flush and isolate existing 6-inch WAS pipe.
- b. Complete all demolition work on WAS pipe.
- c. Complete installation, testing, and acceptance of new equipment.
- d. CITY will place WAS pipe back into service.

D. RAS Pump Station No. 1 Replacement

1. General Requirements:

- a. The CONTRACTOR shall notify the CITY in writing 21 days in advance of any work done in the RAS Pump Station.
- b. The CONTRACTOR shall be responsible for draining and dewatering the existing pipe lines as required to complete work. The CONTRACTOR is responsible for disposal of contents of the existing lines.
- c. The CONTRACTOR shall request clarifier shutdowns from the CITY in writing 14 days in advance of scheduled work.
- d. The CITY will drain each Clarifier upon shutdown. The CONTRACTOR shall then be responsible for draining and dewatering residual water and debris in the Clarifier drain lines and RAS suction valves proposed for replacement, as required to complete the work. The CONTRACTOR is responsible for disposal of contents of the existing lines.
- e. Clarifier No. 2 is limited to one shutdown of three months in duration to perform all work for the project that requires this clarifier to be off line. This work includes the replacement of RAS Pump Nos. 2 and 3 and associated motors, suction valves, discharge valves, and piping (both internal and external to the RAS PS Building, as indicated on the Drawings) as well as startup and testing of the newly installed equipment, piping and accessories. It also includes all structural rehabilitation that requires the shutdown of Clarifier No. 2, including leak repairs.
- f. Clarifier No. 1 is limited to one shutdown of two months in duration to perform all work for the project that requires this clarifier to be off line. The

work includes the replacement of RAS Pump No. 1 and associated motor, suction valves, discharge valves, and piping (both internal and external to the RAS PS Building, as indicated on the Drawings) as well as startup and testing of the newly installed equipment, piping and accessories.

- g. The shutdown periods for Clarifier Nos. 1 and 2 may not occur at the same time with the exception of a single period of two weeks duration to perform work in the RAS PS-1 Electrical Room and the RAS Pump Station. Shutdown shall also be simultaneous with WAS piping modifications. All electrical, mechanical, structural and architectural work which requires de-energizing of the existing MCCs, including removal and salvage of the existing MCC-1C equipment, modifications to existing motor control center MCC-1CA, removal/replacement of the existing variable frequency drives and associated wiring, and removal/replacement of the existing disconnects from service shall be completed within this two week period.
- h. The CONTRACTOR shall be informed that the effluent channel of Clarifier No. 2 is hydraulically connected to Clarifier Nos. 1, 3 and 4. All structural rehabilitation including leak repairs performed within the effluent channel will require isolation of a portion of the effluent channel as shown on the Drawings. It is noted that isolation activities must be completed while Clarifier Nos. 1, 3 and 4 remain in service and will require the use of divers for installation and removal of isolation bulkheads.
- i. The CONTRACTOR shall be responsible for pumping out the liquid contents of the isolated portion of the Clarifier effluent channel to a location within the plant designated by CITY personnel.

2. Detailed Sequence of Construction:

- a. Coordinate with CITY to remove Clarifier No. 2 from service.
- b. Complete structural rehabilitation work:
 - i. Construct bulkheads in Clarifier effluent channel where shown on Drawings. The CONTRACTOR shall be informed that the Clarifier effluent channel shall be in service during this time.
 - ii. Pump out/remove contents of isolated portion of Clarifier effluent channel.
 - iii. Perform all required structural rehabilitation, including crack repairs and leak repairs in Clarifier effluent channel and RAS Pump Station.
 - iv. Obtain written acceptance from ENGINEER and CITY for all structural rehabilitation work.
- c. Complete partial pump station replacement work (RAS Pump Nos. 2 and 3, Clarifier No. 2 Drain/RAS piping work):

- i. Coordinate with City to isolate RAS Pump Nos. 2 and 3 from RAS Pump No. 1 (to remain in service) by isolating suction header at the isolation valve between RAS Pump No. 1 and RAS Pump No. 2.
 - ii. Coordinate with City to drain Clarifier No. 2 in preparation of clarifier drain and RAS suction piping/valve replacement.
 - iii. Replace RAS Pump Nos. 2 and 3 and associated motors, isolation valves, and piping, including Clarifier No. 2 Drain and RAS Suction Valves/Piping external to building, as indicated on the Drawings. Required temporary fittings, supports, plugs, pipe restraining systems, and pipe spool pieces shall be provided by CONTRACTOR at no additional cost to CITY.
 - iv. Perform required startup and testing activities for new equipment.
 - v. Perform structural repair at RAS suction line wall pipe replacement.
 - vi. Once new equipment is accepted by the Engineer, backfill, and compact all excavated areas south of RAS Pump Station No. 1.
- d. Items 1.08 C (2) c and 1.08 C (2) b may be performed simultaneously.
- e. Coordinate with CITY to remove Clarifier No. 1 from service (with Clarifier No. 2 out of service).
- f. Complete all work requiring simultaneous shutdown of both Clarifier Nos. 1 and 2.
- i. Remove and salvage sections of the existing motor control center MCC-1C, variable frequency drives for RAS Pumps 1, 2 and 3, isolation transformers and associated wiring. Install new variable frequency drives for RAS Pumps 1, 2 and 3, associated wiring within existing motor control center MCC-1CA modifications.
 - ii. Remove and replace existing disconnects in RAS Pump Station No. 1 with new disconnects.
 - iii. Perform modifications to WAS piping as shown on drawings.
 - iv. Replace isolation valve on suction header between RAS Pump Nos. 1 and 2. Required temporary fittings, supports, plugs, pipe restraining systems, and pipe spool pieces shall be provided by CONTRACTOR at no additional cost to CITY.
- g. Coordinate with CITY to place Clarifier No. 2 into service.
- h. Complete partial pump station replacement work (RAS Pump No. 1, Clarifier No. 1 Drain/RAS piping work):
- i. Coordinate with City to isolate RAS Pump No. 1 from service and

to isolate suction header at the (new) isolation valve between RAS Pump No. 1 and RAS Pump No. 2.

- ii. Coordinate with City to drain Clarifier No. 1 in preparation of clarifier drain and RAS suction piping/valve replacement.
- iii. Replace RAS Pump No. 1 and associated motor, isolation valves, and piping, including Clarifier No. 1 Drain and RAS Suction Valves/Piping external to building, as indicated on the Drawings. Required temporary fittings, supports, plugs, pipe restraining systems, and pipe spool pieces shall be provided by CONTRACTOR at no additional cost to CITY.
- iv. Perform structural repair at RAS suction line wall pipe replacement.
- v. Perform required startup and testing activities for new equipment, including pump performance testing with newly installed variable frequency drives for ALL pumps.
- i. Complete all installation and limited testing, proving and acceptance of new equipment for RAS Pump Station and MCC Building.
- j. Coordinate with CITY to place Clarifier No. 1 back into service.
- k. Complete all remaining testing, proving and acceptance of new equipment for RAS Pump Station No. 1 and MCC Building.
- l. Once all new equipment is accepted by the Engineer, backfill and compact remaining areas. Restore all areas to existing or better condition for a complete and operable system.
- m. Replace RAS Pump Station No. 1 walkway with new FRP walkway and complete all other remaining work.

1.09 WORK PLAN

- A. The Contractor shall submit a detailed, written Work Plan for each detailed sequence item described below to the CITY 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) through (D), including all activities required by CITY
 - 2. Anticipated dates and duration of each activity, including all activities required by CITY
 - 3. The Work Plan shall include a detailed plan for tie-ins and shut downs

PART 2 -- PRODUCTS (Not Used)

PART 3 – EXECUTION

3.01 COORDINATION WITH EXISTING UTILITIES AND OTHER AGENCIES

- A. The CONTRACTOR shall notify all utilities including but not limited to FPL, BellSouth, and Comcast Cable in writing with a copy to the CITY/ENGINEER prior to construction commencement. The CONTRACTOR shall cooperate with these utility owners as necessary to minimize service interruptions. The CONTRACTOR shall coordinate with Sunshine One-Call Notification at 1-800-432-4770 a minimum of 48 hours prior to any excavation for location of existing underground facilities.

3.02 COOPERATION

- A. The CONTRACTOR shall allow the CITY or its agents, and other project contractors or their agents, to enter facilities being constructed under this Contract for the purpose of constructing, installing, operating, maintaining, removing, repairing, altering or replacing such equipment pipes, sewers, conduits, manholes, wires, or other structures and appliances which may be required to be installed at or in the Work Area. The CONTRACTOR shall cooperate with all the aforesaid parties and shall allow reasonable provisions for the prosecution of any other work by the CITY, or others, to be done in connection with his work, or in connection with normal use of the facilities.

- END OF SECTION -

SECTION 01530 - PROTECTION OF EXISTING FACILITIES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The CONTRACTOR shall protect all existing utilities and improvements not designated for removal and shall restore damaged or temporarily relocated utilities and improvements to a condition equal to or better than they were prior to such damage or temporary relocation, all in accordance with requirements of the Contract Documents.
- B. The CONTRACTOR shall verify the exact locations and depths of all utilities shown and the CONTRACTOR shall make exploratory excavations of all utilities that may interfere with the Work. All such exploratory excavations shall be performed as soon as practicable after award of Contract and, in any event, a sufficient time in advance of construction to avoid possible delays to the CONTRACTOR'S Work. When such exploratory excavations show the utility location as shown to be in error, the CONTRACTOR shall so notify the CITY.
- C. The number of exploratory excavations required shall be that number which is sufficient to determine the alignment and grade of the utility.

1.02 RIGHTS-OF-WAY

- A. The CONTRACTOR shall not enter upon any rights-of-way involved until notified that the CITY has secured authority therefore from the proper party. After authority has been obtained, the CONTRACTOR shall give said party due notice of its intention to begin Work, and shall give said party convenient access and opportunity for removing, shoring, supporting, or otherwise protecting utilities or structures within the right-of-way. When two or more contracts are being executed at one time on the same or adjacent land in such manner that Work on one contract may interfere with that on another, the CITY shall determine the sequence and order of the Work.

1.03 PROTECTION OF STREET OR ROADWAY MARKERS

- A. The CONTRACTOR shall not destroy, remove, or otherwise disturb any existing survey markers or other existing street or roadway markers without proper authorization. No pavement breaking or excavation shall be started until all survey or other permanent marker points that will be disturbed by the construction operations have been properly referenced for easy and accurate restoration. It shall be the CONTRACTOR'S responsibility to notify the proper representatives of the CITY of the time and location that Work will be done. Such notification shall be sufficiently in advance of construction so that there will be no delay due to waiting for survey points to be satisfactorily referenced for restoration. All survey markers or points disturbed by the CONTRACTOR without proper authorization by the CITY, will be accurately restored by the CITY at the CONTRACTOR'S expense after all street or roadway resurfacing has been completed.

1.04 RESTORATION OF FACILITIES

- A. General: All paved areas including asphaltic concrete berms cut or damaged during construction shall be replaced with similar materials and of equal thickness to match the existing adjacent undisturbed areas, except where specific resurfacing requirements have been called for in the Contract Documents or in the requirements of the agency issuing the permit. All temporary and permanent pavement shall conform to the requirements of the CITY. All pavements which are subject to partial removal shall be neatly saw cut in straight lines. All paved areas including asphaltic concrete berms cut or damaged during construction shall be replaced with similar materials and of equal thickness to match the existing adjacent undisturbed areas, except where specific restoration requirements have been called for in the Contract Documents or in the requirements of the agency issuing the permit.
- B. Temporary Restoration: Temporary restoration includes repair to all driveways, sidewalks and roadways. They shall be swept clean and be maintained free of dirt and dust. All areas disturbed by the construction activities shall be restored to proper grade, cleaned up, including the removal of debris, trash, and deleterious materials. All construction materials, supplies, or equipment, including piles of debris shall be removed from the area. All temporarily restored areas shall be maintained by the CONTRACTOR. These areas shall be kept clean and neat, free of dust and dirt, until final restoration operations are completed. The CONTRACTOR is responsible to utilize dust abatement operations in the temporarily restored areas as required, to the satisfaction of the ENGINEER.
- C. Temporary Resurfacing: Wherever required by the public authorities having jurisdiction, the CONTRACTOR shall place temporary surfacing promptly after backfilling and shall maintain such surfacing for the period of time fixed by said authorities before proceeding with the final restoration and improvements.
- D. Permanent Resurfacing: In order to obtain a satisfactory junction with adjacent surfaces, the CONTRACTOR shall saw cut back and trim the edge so as to provide a clean, sound, vertical joint before permanent replacement of an excavated or damaged portion of pavement. Damaged edges of pavement along excavations and elsewhere shall be trimmed back by saw cutting in straight lines. All pavement restoration and other facilities restoration shall be constructed to finish grades compatible with adjacent undisturbed pavement, unless otherwise shown on the drawings:
- E. Final Restoration: Final restoration shall include the completion of all required pavement replacement of roadways, driveways, curbs, gutters, sidewalks and other existing improvements disturbed by the construction: final grading, placement of sod, installation or replacement of any trees or shrubs, repair of irrigation systems, pavement marking, etc., all complete and finished, acceptable to the ENGINEER.

1.05 EXISTING UTILITIES AND IMPROVEMENTS

- A. General: The CONTRACTOR shall protect all underground utilities and other improvements which may be impaired during construction operations. It shall be the CONTRACTOR'S responsibility to ascertain the actual location of all existing utilities and other improvements that will be encountered in its construction operations, and to

see that such utilities or other improvements are adequately protected from damage due to such operations.

- B. Where the proper completion of the Work requires the temporary or permanent removal and / or relocation of an existing utility or other improvement which is shown, the CONTRACTOR shall remove and temporarily replace or relocate such utility or improvement in a manner satisfactory to the CITY and the OWNER of the utility/facility. In all cases of such temporary removal or relocation, restoration to former location shall be accomplished by the CONTRACTOR in a manner that will restore or replace the utility or improvement as nearly as possible to its former locations and to as good or better condition than found prior to removal.
- C. CITY'S Right of Access: The right is reserved to the CITY and to the OWNER'S of public utilities and franchises to enter at any time upon any public street, alley, right-of-way, or easement for the purpose of making changes in their property made necessary by the Work of this Contract.
- D. Underground Utilities Shown or Indicated: Existing utility lines that are shown or the locations of which are made known to the CONTRACTOR prior to excavation and that are to be retained, and all utility lines that are constructed during excavation operations shall be protected from damage during excavation and backfilling and, if damaged, shall be immediately repaired by the CONTRACTOR.
- E. Underground Utilities Not Shown or Indicated: In the event that the CONTRACTOR damages any existing utility lines that are not shown or the locations of which are not made known to the CONTRACTOR prior to excavation, a written report thereof shall be made immediately to the CITY. If directed by the CITY, repairs shall be made by the CONTRACTOR under the provisions for changes and extra Work contained in the General Conditions.
- F. Approval of Repairs: All repairs to a damaged improvement are subject to inspection and approval by an authorized representative of the improvement and CITY before being concealed by backfill or other Work.
- G. No fill, excavation material, construction generated debris or equipment shall obstruct water valves, gas meters or sewer manholes. Water, sewer and gas service shall be made accessible to repair or maintenance crews representing the CITY or a privately-owned utility company.
- H. Maintaining in Service: All oil and gasoline pipelines, power, and telephone or other communication cable ducts, gas and water mains, irrigation lines, sewer lines, storm drain lines, poles, and overhead power and communication wires and cables encountered along the line of the Work shall remain continuously in service during all the operations under the Contract, unless other arrangements satisfactory to the CITY are made with the owner of said pipelines, duct, main, irrigation line, sewer, storm drain, pole, or wire or cable. The CONTRACTOR shall be responsible for and shall repair all damage due to its operations, and the provisions of this Section shall not be abated even in the event such damage occurs after backfilling or is not discovered until after completion of the backfilling.

PART 2 -- PRODUCTS (Not Used)

PART 3 -- EXECUTION (Not Used)

- END OF SECTION -

SECTION 01550 - SITE ACCESS AND STORAGE

PART 1 -- GENERAL

1.01 SITE ACCESS

- A. The CONTRACTOR shall make its own investigation of the condition of available public and private roads and of clearances, restrictions, bridge load limits, and other limitations affecting transportation and ingress and egress to the site of the Work. It shall be the CONTRACTOR's responsibility to construct and maintain any haul roads required for its construction operations.
- B. The Southern Regional Wastewater Treatment Plant maintains a perimeter chain link fence and security gate. Delivery and employee access to the plant will be via the plant access electronic gate and security guard. Vehicles entering or leaving the plant will be required to check in with the security guard located at the gate.
- C. The CONTRACTOR will be responsible for monitoring the main gate for its personnel, equipment and material deliveries.

1.02 STORAGE

- A. Limited storage area is available within the work areas shown on the Drawings. Any equipment and materials stored here shall be in accordance with the manufacturer's recommendations and as indicated by the CITY.
- B. Responsibility for protection and safekeeping of equipment and materials will be solely that of the CONTRACTOR, and no claim shall be made against the CITY by reason of any act of an employee or trespasser. Should an occasion arise necessitating access to an area occupied by stored equipment and/or materials, the CONTRACTOR shall immediately move them.
- C. If the CONTRACTOR requires additional staging and storage area than shown on the Drawings, the CONTRACTOR shall obtain such areas from off site sources at no additional cost to the CITY.
- D. Upon completion of the Contract, the CONTRACTOR shall remove from the storage and work areas all of their equipment, temporary fencing, surplus materials, rubbish, etc., and restore the area to its original or better conditions.

PART 2 -- PRODUCTS (Not Used)

PART 3 -- EXECUTION (Not Used)

- END OF SECTION -

SECTION 01560 – TEMPORARY ENVIRONMENTAL CONTROLS

PART 1 -- GENERAL

1.01 CHEMICALS

- A. All chemicals used during project construction or furnished for testing of project operation, whether herbicide, pesticide, disinfectant, polymer, reactant of other classification, will be required to show approval of either EPA or HUD. The handling, use, storage and disposal of such materials, containers or residues shall be in strict conformance with manufacturer and/or CONTRACTOR'S secured storage. Copies of antidote literature and a supply of antidotes shall be kept at the job site office.

1.02 DUST

- A. During all work for this Contract, the CONTRACTOR shall by the application of water and/or calcium chloride or other means, approved by the ENGINEER, eliminate dust annoyance to adjacent property, business establishments and the plant site as specified in Section 00700 - General Conditions. The CONTRACTOR shall take all protective measures, to the satisfaction of the ENGINEER, necessary to ensure that dust and debris does not enter any of the mechanical or electrical equipment. The CONTRACTOR shall be responsible for the cleanup of existing buildings, equipment, controls, etc., which have become soiled due to the lack of proper dust control as determined by the ENGINEER. The CONTRACTOR shall provide daily application of water to all unpaved areas designated by the ENGINEER in the field and to the satisfaction of the ENGINEER in the field.

1.03 NOISE

- A. Noise resulting from the CONTRACTOR'S work shall not violate the Hollywood Code of Ordinance Chapter 100, with specific note to the restrictions of paragraph 100.05 or exceed the noise levels and other requirements stated in the Broward County Chapter 27 Pollution Control, relating to noise abatement in Broward County. The CONTRACTOR shall be responsible for curtailing noise resulting from his operation. He shall, upon written notification from the ENGINEER or the noise control officers, make any repairs, replacements, adjustments, additions and furnish mufflers when necessary to fulfill requirements.

1.04 EROSION ABATEMENT AND WATER POLLUTION

- A. It is imperative that the CONTRACTOR'S dewatering operations not contaminate or disturb the plant environment or properties adjacent to the Work. The CONTRACTOR, shall, therefore, schedule and control his operations to confine all runoff water from disturbed surfaces, water from dewatering and/or from excavation below the ground water table operations that becomes contaminated with lime silt, muck and other deleterious matter, fuels, oils, bitumens, calcium chloride, chemicals and other polluting materials.

- B. The CONTRACTOR shall construct temporary stilling basin(s) of adequate size and provide all necessary temporary materials, operations and controls including, but not limited to, filters, coagulants, screens and other means necessary to attain the required discharge water quality.
- C. The CONTRACTOR shall be responsible for providing, operating and maintaining materials and equipment used for conveying the clear water to the point of discharge. All pollution prevention procedures, materials, equipment and related items shall be operated and maintained until such time as the dewatering operation is discontinued. Upon the removal of the materials, equipment and related items the CONTRACTOR shall restore the area to the condition prior to his commencing work.

1.05 HURRICANE AND STORM WARNINGS

- A. As the schedule for this project coincides, in part, with the recognized South Florida hurricane season, the CONTRACTOR's attention is drawn to the possibility of hurricane conditions, or severe storm conditions, occurring at the job and plant site during the course of Contract work.
- B. Within 30-days of the date of Notice-to-Proceed, the CONTRACTOR shall submit to the ENGINEER and CITY a Hurricane Preparedness Plan. The plan should outline the necessary measures which the CONTRACTOR proposes to perform at no additional cost to the CITY in case of a hurricane warning.
- C. In the event of inclement weather, or whenever the ENGINEER shall direct, the CONTRACTOR shall, and will cause Sub-Contractors to protect carefully the Work and materials against damage or injury by reasons of failure on the part of the CONTRACTOR to so protect the Work. Such Work and materials so damaged shall be removed and replaced at the expense of the CONTRACTOR.
 - 1. Hurricane Watch: Upon designation of a hurricane watch, CONTRACTORS shall be responsible for storing all loose supplies and equipment on the job site that may pose a danger. The CONTRACTOR shall backfill all open holes in preparation of inclement weather. In addition, the CONTRACTOR shall remove all bulkheads and plugs in pipelines that would impede drainage in the case of flooding. Structures that may be in danger of floatation shall be flooded. The CONTRACTOR shall also cooperate with CITY personnel in protecting other structures at the site.
 - 2. Hurricane Warning: No mobile "temporary facility" under the control of the City of Hollywood, or on City property, shall be staffed during a hurricane warning. CONTRACTOR facilities meeting these criteria shall comply.
- D. The CONTRACTOR is advised to take all necessary precautions to protect his equipment by moving it to higher ground if in an area subject to flooding. Known areas of Hollywood that would be subject to flooding from storm tides include:

Hollywood Blvd.	North Lake Area	South Lake Area
A1A	Sheridan Street	Dania Beach Blvd.
US Highway 1	46 th Avenue	Hallandale Beach Blvd.

1.06 PESTS AND RODENTS

- A. The CONTRACTOR shall be responsible for maintaining the jobsite free from litter, rubbish and garbage. He shall provide containers for the disposal of garbage and other materials that attract and are breeding places for pests and rodents. The CONTRACTOR shall provide the services of an exterminator to inspect the jobsite on a periodic basis and to provide service as required to control pests and rodents.

1.07 PERIODIC CLEAN-UP; BASIC SITE RESTORATION

- A. During construction, the CONTRACTOR shall regularly remove from the site all accumulated debris and surplus materials of any kind which result from his operations, or whenever the accumulation is in excess of one truck load. Unused equipment and tools shall be stored at the CONTRACTOR'S yard or base of operations for the project.
- B. When the work involves installation of sewers, drains, water mains, manholes, underground structures, or other disturbance of existing features in or across streets, rights-of-way, easements, or private property, the CONTRACTOR shall (as the work progresses) promptly backfill, compact, grade and otherwise restore the disturbed area to a basic condition which will permit resumption of pedestrian or vehicular traffic and any other critical activity or function consistent with the original use of the land. Unsightly mounds of earth, large stones, boulders, and debris shall be removed so that the site presents a neat appearance.
- C. The CONTRACTOR shall perform the clean-up work on a regular basis and as frequently as ordered by the ENGINEER. Basic site restoration in a particular area shall be accomplished immediately following the installation or completion of the required facilities in that area. Furthermore, such work shall also be accomplished, when ordered by the ENGINEER, if partially completed facilities must remain incomplete for some time period due to unforeseen circumstances.
- D. Upon failure of the CONTRACTOR to perform periodic clean-up and basic restoration of the site to the ENGINEER'S satisfaction, the ENGINEER may, upon five (5) days prior written notice to the CONTRACTOR, employ such labor and equipment as he deems necessary for the purpose, and all costs resulting therefrom shall be charged to the CONTRACTOR and deducted from the amounts of money that may be due him.

1.08 SECURITY

- A. The CONTRACTOR shall care for and protect against loss or damage of all material to be incorporated in the construction for the duration of the Contract and shall repair or replace damaged or lost materials and damage to structures.
- B. The CONTRACTOR shall be responsible for providing, and maintaining temporary fencing and gates and the daily securing of temporary fencing and gates used for construction purposes for the duration of the project.
- C. The CONTRACTOR shall strictly comply with working hours on the project site. Prior to any work outside of the standard working hours, the CONTRACTOR shall request the CITY's approval via written request (at least 8 hours in advance). The written request shall clearly define the work to be performed, the names of the employees, their

employer and their trade and the hours and days during which the work is planned. The CITY is considering and the CONTRACTOR shall comply with additional security requirements including employee photo identification at all times on-site and employee parking passes.

1.09 CHLORINE EMERGENCY PREPARATION

- A. The CONTRACTOR's attention is directed to the CITY's policy of conducting periodic chlorine emergency drills at the WWTP. The drills are intended to ensure readiness to respond to a potential emergency due to the leakage of chlorine gas (which is a toxic substance) from the Chlorine Facility at the WWTP. The CONTRACTOR shall designate an on-site member of his staff that will be trained by the CITY and be responsible for ensuring that the CONTRACTOR's and subcontractor's personnel fully participate in the drills and are prepared to deal with a potential emergency. The CONTRACTOR shall submit for each WWTP operation shift change (before 9:00 A.M., 5:00 P.M., 1:00 A.M.) a list of names of these employees and all subcontractor's employees working on the project site during construction of the interceptor structure.

PART 2 -- PRODUCTS (Not Used)

PART 3 -- EXECUTION (Not Used)

- END OF SECTION -

SECTION 01590 – FIELD OFFICE, EQUIPMENT AND SERVICES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The CONTRACTOR is not required to provide a field office. Should the CONTRACTOR elect to provide a field office, the CONTRACTOR is responsible for providing a suitable location for the field office. The CITY will not provide an area for a field office for the work.
- B. If field offices are to be furnished and installed, the CONTRACTOR shall be responsible for providing temporary utilities including power, lighting, heating, cooling, and ventilating, water, sanitary and personnel facilities, telephone service, and fire protection as required.
- C. The CONTRACTOR shall be responsible for providing sufficient area for employee parking at the field office. The CITY will not provide parking area for CONTRACTOR's employee parking.
- D. If applicable, the CONTRACTOR shall prepare and submit all required drawings with sufficient detail as necessary to the City of Hollywood Building Department for permitting of the field office and utility hookups. The CONTRACTOR shall comply with all Building Department requirements accordingly.

PART 2 -- PRODUCTS (Not Used)

PART 3 -- EXECUTION (Not Used)

- END OF SECTION -

SECTION 01600 – EQUIPMENT AND MATERIALS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The word "Products," as used herein is defined to include purchased items for incorporation into the Work, regardless of whether specifically purchased for project or taken from CONTRACTOR's stock of previously purchased products. The word "Materials," is defined as products which must be substantially cut, shaped, worked, mixed, finished, refined, or otherwise fabricated, processed, installed, or applied to form units of Work. The word "Equipment" is defined as products with operational parts, regardless of whether motorized or manually operated, and particularly including products with service connections (wiring, piping, and other like items). Definitions in this paragraph are not intended to negate the meaning of other terms used in Contract Documents, including "specialties," "systems," "structure," "finishes," "accessories," "furnishings," special construction," and similar terms, which are self-explanatory and have recognized meanings in the construction industry.
- B. Equipment Specifications may not deal individually with minute items required such as components, parts, controls, and devices which may be required to produce the equipment performance specified or as required to meet the equipment warranties. Where such items are required, they shall be included by the supplier of the equipment, whether or not specifically called for in the Contract Documents.
- C. All equipment, materials, instruments or devices incorporated in this project shall be new and unused, unless indicated otherwise in the Contract Documents. Equipment and materials to be incorporated into the work shall be delivered sufficiently in advance of their installation and use to prevent delay in the execution of the work, and they shall be delivered as nearly as feasible in the order required for executing the work.
- D. Where the words "furnish", "provide", "supply", "replace", or "install" are used, whether singularly or in combination, they shall mean to furnish and install, unless specifically stated otherwise.
- E. In the interest of brevity, the explicit direction "to furnish and install" has sometimes been omitted in specifying materials and/or equipment herein. Unless specifically noted otherwise, it shall be understood that all equipment and/or materials specified or shown on the Drawings shall be furnished and installed under the Contract as designated on the Drawings.

1.02 INSTALLATION OF EQUIPMENT

- A. Equipment and materials shall be installed in accordance with the requirements of the General Conditions, Supplemental Conditions and the respective Specification Sections.
- B. Concrete foundations for equipment shall be of approved design and shall be adequate in size, suitable for the equipment erected thereon, properly reinforced, and tied into floor slabs by means of reinforcing bars or dowels. Foundation bolts of ample size and strength shall be provided and properly positioned by means of suitable templates and secured

during placement of concrete. Foundations shall be built and bolts installed in accordance with the manufacturer's certified drawings.

- C. Before mounting equipment on a foundation, the CONTRACTOR shall clean the top surface; if necessary, rough it with a star chisel and clean again; and clean out all foundation bolt sleeves. The CONTRACTOR shall provide a sufficient number of stainless steel plate shims about 2-inches wide and 4-inches long, and of a varying thickness from 1/8 to 1/2 inch. A combination of these shims shall be placed next to each foundation bolt to bring the bottom of the bedplate or frame about 1/8 inch above the final setting. The equipment shall be lowered by changing the combination of shims. Using stainless steel shim stock of various thicknesses, continue to level the equipment a little at a time and in rotation until it is at the correct elevation in both directions. When the equipment is level, tighten down on the foundation bolts a little at a time in rotation to make certain the equipment remains level and does not shift on the shims. A preliminary alignment check shall be made before grout is placed.
- D. Equipment shall be set, aligned and assembled in conformance with manufacturer's drawings or instructions. Run out tolerances by dial indicator method of alignment shall be plus or minus .002 inches, unless otherwise directed by the CITY.
- E. All blocking and wedging required for the proper support and leveling of equipment during installation shall be furnished by the CONTRACTOR. All temporary supports shall be removed, except stainless steel wedges and shims, which may be left in place with the approval of the CITY.
- F. Each piece of equipment or supporting base, bearing on concrete foundations, shall be bedded in grout. The CONTRACTOR shall provide a minimum of 1-1/2-inch thick grouting under the entire baseplate supporting each pump, motor drive unit and other equipment. Grout shall be non-shrink grout, as specified under Section 03315 entitled "Grout".
- G. When motors are shipped separately from driven equipment, the motors shall be received, stored, meggered once a month, and the reports submitted to the CITY. After driven equipment is set, the motors shall be set, mounted, shimmed, millrighted, coupled and connected complete. Motors shall then be turned once per month and documented by the CONTRACTOR to the CITY.

1.03 CONNECTIONS TO EQUIPMENT

- A. Connections to equipment shall follow manufacturer's recommendations as to size and arrangement of connections and/or as shown in detail on the Drawings or approved Shop Drawings. Piping connections shall be made to permit ready disconnection of equipment with minimum disturbance of adjoining piping and equipment.
- B. The Electrical CONTRACTOR or CONTRACTOR if no electrical contract exists shall be responsible for bringing proper electrical service to each item of equipment requiring electrical service as shown on the Drawings or approved Shop Drawings. Electrical connections to equipment requiring electrical service shall be made by the Electrical CONTRACTOR, unless otherwise indicated on the Drawings or in the Technical Specifications.

- C. The HVAC CONTRACTOR or CONTRACTOR if no HVAC Contract exists shall bring and connect HVAC service to all equipment items requiring same as shown on the Drawings. Electrical connections to equipment requiring electrical service shall be made by the Electrical CONTRACTOR, unless otherwise indicated on the Drawings or in the Technical Specifications.
- D. The Plumbing CONTRACTOR or CONTRACTOR if no plumbing contract exists shall bring and connect plumbing service to all equipment items requiring same as shown on the Drawings.

1.04 IDENTIFICATION TAGS FOR EQUIPMENT AND INSTRUMENTS

- A. All process equipment, pumps, blowers, valves, gates and process instruments that are identified by a tag number on the Process and Instrumentation Diagrams (P&IDs on Instrumentation contract drawings) shall have an identification tag at the device.
- B. The identification tag shall show a unique tag number for the device (e.g., CFP-6010), and the common name of the device (e.g., Centrifuge Feed Pump No. 1).
- C. The identification tag shall be either lamacoid tag with white background and black core letters, or non-corrosive metal tags, ASTM A240 Grade 430 stainless steel with a bright annealed finish.
- D. Characters on identification tags shall be 3/16" high and surface cut deep unless otherwise noted. Characters shall be cut into the lamacoid tags with a hardened steel router bit and into stainless steel tags with a diamond tip cutter.
- E. Identification tags shall be buffed around the perimeter to remove any sharp edges or corners.
- F. Identification tags shall be attached to the equipment item, valve, or instrument with 0.9 mm diameter wire or stainless steel screws.

1.05 PRODUCT DELIVERY-STORAGE-HANDLING

- A. The CONTRACTOR shall deliver, handle, and store products in accordance with supplier's written recommendations and by methods and means which will prevent damage, deterioration, and loss including theft. Delivery schedules shall be controlled to minimize long-term storage of products at site and overcrowding of construction spaces. In particular, the CONTRACTOR shall provide delivery/installation coordination to ensure minimum holding or storage times for products recognized to be flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other sources of loss. Any equipment or materials of whatever kind which may have become damaged or deteriorated from any cause shall be removed and replaced by good and satisfactory items at the CONTRACTOR's expense for both labor and materials.

1.06 TRANSPORTATION AND HANDLING

- A. Products shall be transported by methods to avoid product damage and shall be delivered in undamaged condition in supplier's unopened containers or packaging, dry.

- B. The CONTRACTOR shall provide equipment and personnel to handle products, materials, and equipment including those provided by CITY, by methods to prevent soiling and damage.
- C. The CONTRACTOR shall provide additional protection during handling to prevent marring and otherwise damaging products, packaging, and surrounding surfaces.

1.07 STORAGE AND PROTECTION

- A. The CONTRACTOR shall protect all equipment and materials from deterioration and damage, including provisions for temporary storage buildings as needed and as specified in Section 01550 entitled "Site Access and Storage".
- B. Products shall be stored in accordance with supplier's written instructions, with seals and labels intact and legible. Sensitive products shall be stored in weather-tight enclosures and temperature and humidity ranges shall be maintained within tolerances required by supplier's written instructions.
- C. Storage of equipment and materials shall be in locations completely protected from flooding, standing water, excessive dust, falling rock, brush fire, etc. Storage areas shall be located sufficiently distant from all construction activities and the movement of construction vehicles to minimize the potential for accidental damage.
- D. For exterior storage of fabricated products, they shall be placed on sloped supports above ground. Products subject to deterioration shall be covered with impervious sheet covering; ventilation shall be provided to avoid condensation.
- E. Loose granular materials shall be stored on solid surfaces in a well drained area and shall be prevented from mixing with foreign matter.
- F. Storage shall be arranged to provide access for inspection. The CONTRACTOR shall periodically inspect to assure products are undamaged and are maintained under required conditions.
- G. Storage shall be arranged in a manner to provide access for maintenance of stored items and for inspection.

1.08 MAINTENANCE OF STORAGE

- A. Stored products shall be periodically inspected on a scheduled basis. The CONTRACTOR shall maintain a log of inspections and shall make said log available to the ENGINEER on request.
- B. The CONTRACTOR shall verify that storage facilities comply with supplier's product storage requirements.
- C. The CONTRACTOR shall verify that supplier-required environmental conditions are maintained continually.

- D. The CONTRACTOR shall verify that surfaces of products exposed to the elements are not adversely affected and that any weathering of finishes is acceptable under requirements of Contract Documents.

1.09 MAINTENANCE OF EQUIPMENT STORAGE

- A. For mechanical and electrical equipment in long-term storage, the CONTRACTOR shall provide a copy of the supplier's service instructions to accompany each item, with notice on enclosed instruction shown on exterior of package.
- B. Equipment shall be serviced on a regularly scheduled basis, and a log of services shall be maintained and submitted as a record document to the ENGINEER.

1.10 LUBRICANTS

- A. During testing and prior to acceptance, the CONTRACTOR shall furnish all lubricants necessary for the proper lubrication of all equipment furnished under this Contract.

1.11 SPECIAL TOOLS

- A. For each type of equipment furnished by him, the CONTRACTOR shall provide a complete set of all special tools (including calibration and test equipment) which may be necessary for the adjustment, operation, maintenance and disassembly of such equipment.
- B. Special tools shall be delivered at the same time as the equipment to which they pertain. The CONTRACTOR shall properly store and safeguard such special tools until completion of the Work, at which time they shall be delivered to the CITY.

1.12 PROTECTION AGAINST ELECTROLYSIS

- A. Where dissimilar metals are used in conjunction with each other, suitable insulation shall be provided between adjoining surfaces so as to eliminate direct contact and any resultant electrolysis. The insulation shall be bituminous impregnated felt, heavy bituminous coatings, nonmetallic separators or washers, or other acceptable materials.

1.13 FASTENERS

- A. All necessary bolts, anchor bolts, nuts, washers, plates and bolt sleeves shall be furnished by the CONTRACTOR in accordance herewith. Bolts shall have suitable washers and, where so required, their nuts shall be hexagonal.
- B. All bolts, anchor bolts, nuts, washers, plates, and bolt sleeves shall be Type 316 stainless steel unless otherwise specifically indicated or specified.
- C. Unless otherwise specified, stud, tap, and machine bolts shall be of the best quality refined bar iron. Hexagonal nuts of the same quality of metal as the bolts shall be used.

1.14 EXCAVATED MATERIALS

- A. All excavated materials needed for backfilling operation shall be stored on site. Where additional area is needed for stockpiling, it shall be obtained by the CONTRACTOR.

B. Any excess backfill shall be delivered to the CITY's property as directed by the ENGINEER.

PART 2 -- PRODUCTS

(NOT USED)

PART 3 -- EXECUTION

(NOT USED)

- END OF SECTION -

SECTION 01650 - EQUIPMENT TESTING AND STARTUP

PART 1 -- GENERAL

1.01 GENERAL

- A. Equipment testing and startup are requisite to satisfactory completion of the contract and, therefore, shall be completed within the Contract time.
- B. As construction of the project enters the final stages of completion, the CONTRACTOR shall, in accordance with the requirements set forth in the Contract Documents, attend to the following items:
 - 1. Complete all punch list items required by the ENGINEER prior to startup-up.
 - 2. Schedule equipment manufacturer's visits to site.
 - 3. Calibration of instruments and controls.
 - 4. Perform required testing, adjusting and balancing of project components.
 - 5. Complete all punch list items that result from testing.
 - 6. Schedule and coordinate training and testing activities.
 - 7. Furnish skilled personnel from manufacturer's and suppliers during training and testing activities.
 - 8. Furnish operation and maintenance training for CITY's personnel.
 - 9. Successfully demonstrate reliable operation of project systems.
- C. Additional requirements for testing of the pumps are defined in Division 11.

1.02 DEFINITIONS

- A. Facility Startup: Includes putting Project in operating order, cleaning, adjusting and balancing equipment, initial operation (startup) of equipment item, operating equipment, starting systems, operation of systems, testing of equipment and systems, completing required punch list items, and demonstration and verification of the completed facility as a unit.
- B. Functional Testing: A test or tests in the presence of the ENGINEER and/or CITY to demonstrate that the installed equipment or system meets manufacturer's installation and adjustment requirements and other requirements specified including, but not limited to, noise, vibration, alignment, speed, proper operation of electrical, mechanical and information and control equipment, thrust restraint, proper rotation, and initial servicing.
- C. System Performance Testing: A test performed in the presence of the ENGINEER and/or CITY after satisfactory completion of required functional testing, to demonstrate and

confirm that the equipment and/or system meet the specified performance requirements for a specified minimum operation period without significant interruption. System performance testing shall not begin until the following are completed:

1. The CONTRACTOR has submitted written test reports, installation reports, and performance affidavits as required in the Contract Documents.
 2. The CONTRACTOR has completed all punch list items.
 3. The CONTRACTOR has completed all functional testing.
- D. Operation Period: The operation period for Performance Testing shall be as defined in the Supplementary General Conditions without significant interruption.
- E. Significant Interruption: May include any of the following events:
1. Failure of CONTRACTOR to maintain qualified onsite startup personnel as scheduled.
 2. Failure to meet specified performance for more than two consecutive hours.
 3. Failure of any critical equipment unit, system, or subsystem that is not satisfactorily corrected within five hours after failure.
 4. Failure of noncritical unit, system, or subsystem that is not satisfactorily corrected within eight hours after failure.
 5. As may be determined by ENGINEER.
- F. System: The overall process, or a portion thereof, that performs a specific function. A system may consist of two or more subsystems as well as two or more types of equipment. The "System" shall be as determined by the ENGINEER.
- G. Training: The services provided by the CONTRACTOR and his equipment suppliers to ensure that the CITY's staff is completely prepared to operate and maintain the contract facilities. Training shall include classroom instruction, as well as "hands-on" field/equipment demonstration, operation and maintenance. Equipment/contract fabrication shall be 100 percent operational (as defined by the ENGINEER) during training activities.
- 1.03 CONTRACTOR'S RESPONSIBILITIES
- A. The CONTRACTOR shall designate and furnish one or more persons to be responsible for coordinating and expediting CONTRACTOR's facility startup, testing and training duties. The person or persons shall be present during Facility Startup, Functional Testing, and Training meetings and shall be available at all times during the Facility Startup and Training period. In addition, the person or persons shall be "on call" (available to assist the CITY) at all times during the System Performance Testing.
- B. The CONTRACTOR shall provide the services of an experienced and authorized representative of the supplier of each item of equipment (excluding minor items of equipment specifically exempted by the ENGINEER in writing), who shall visit the site of

the Work and inspect, check, adjust if necessary, and approve the equipment installation. In each case, the CONTRACTOR shall arrange to have the supplier's representative revisit the job site as often as necessary until any and all trouble is corrected and the equipment installation and operation are satisfactory to the ENGINEER.

- C. The CONTRACTOR shall require that each supplier's representative furnish to the ENGINEER a written report addressed to the CITY, and copied to the ENGINEER, certifying that the equipment has been properly installed and lubricated, is in accurate alignment, is free from any undue stress imposed by connecting piping or anchor bolts, has been operated satisfactorily under the complete range of, including but not limited to full-load, conditions, is ready for operation and the CITY's operating personnel have been instructed in the operation, maintenance and lubrication of the equipment.
- D. The CONTRACTOR shall furnish all personnel, power, water, chemicals, fuel, oil, grease, and all other necessary equipment, facilities, and services required for conducting the tests.
- E. The CONTRACTOR shall coordinate startup, testing and training activities with CITY/ENGINEER in advance and in writing.

1.04 SUBMITTALS

- A. Test Schedules and Plan: 8 copies of functional and system performance test schedules and plans for equipment, units, and systems shall be submitted to the ENGINEER, in accordance with the Section entitled "Submittals" at least 3 months prior to start of related testing. 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. Testing criteria.
 - 4. Checklists and procedures for performing each test.
 - 5. Sample forms for the collection of test data.
 - 6. Sample test results documentation.
 - 7. Requirements for other parties.
- B. Test Reports and Certificates of Compliance: Functional and performance testing reports, and certificates of compliance, in a format acceptable to the ENGINEER, shall be furnished in accordance with the Section entitled "Submittals". Test reports and certificates of compliance shall be submitted prior to project closeout in accordance with the requirements of the Section entitled "Project Closeout".
- C. Training Schedules and Plan: 8 copies of written training schedule and written training plan shall be submitted to the ENGINEER, in accordance with the Section entitled "Submittals" at least 30 days prior to start of related operation and maintenance training. The training plan shall contain the following at a minimum:

1. A schedule of all training to be conducted. The training schedule shall be adjusted as deemed necessary by the CITY, to allow full participation by the supplier's representative, CITY's personnel and as needed if the operability of the system being trained on is interrupted for any reason. This may require training during three separate shifts.
2. A brief description of the training to be performed.
3. Sample training materials and handouts.
4. Qualifications of the supplier's representative performing the training.
5. Training agenda shall be prepared and submitted to the ENGINEER at least 2 weeks in advance for approval. Rejection of the training agenda may delay the training, at the CITY's option. As a minimum, the agenda shall include but not limit to the following items:
 - General description of the equipment item
 - Start-up procedure
 - Shutdown procedure
 - Operation and control description
 - Adjustment and trouble-shooting
 - Maintenance

The CONTRACTOR shall provide professional audio-video recording (MP4 format) of all training sessions (as selected by the CITY). Two labeled USB flash drives of each training session shall be furnished to the CITY within two weeks of completion of the training.

- D. Written Notification: Any CONTRACTOR activity that may impact operation of existing facilities shall be confirmed in writing at least 48 hours in advance of initiation of that activity. This requirement is in addition to the 30-day advance submittal of plans to more closely confirm coordination efforts required. This notification shall include, as a minimum:
- Scheduled date and time (start, finish, duration) of CONTRACTOR's activity
 - Brief description of activity
 - Brief description of any CITY activity that is required to coordinate with CONTRACTOR's activity (such as shutdown of a unit process or system, power supply, etc.).

1.05 TOOLS

- A. Any special tools which may be necessary for the adjustment, operation, and maintenance of any equipment shall be furnished with the respective equipment. The CONTRACTOR shall furnish a complete list of tools and instructions for their use, recommended by the manufacturer or CONTRACTOR with the Shop Drawing submittal.

1.06 SPARE PARTS

- A. Spare parts for equipment shall be furnished where indicated in the equipment specifications and/or recommended by the equipment manufacturer. Spare parts shall be identical and interchangeable with original parts. Parts shall be supplied, prepared for storage, in clearly identified containers. Large or bulky items shall also be prepared for storage, clearly identified and wrapped in polyethylene or other suitable protection.
- B. The parts shall be stored separately in a locked area, maintained by the CONTRACTOR, and shall be delivered to the CITY as a complete package for each equipment item at a location designated by the CITY. The CONTRACTOR shall furnish an inventory listing all spare parts for each piece of equipment utilizing the form included at the end of this Section.

PART 2 -- PRODUCTS (Not Used)

PART 3 -- EXECUTION

3.01 PREPARATION FOR EQUIPMENT FUNCTIONAL TESTING

- A. Conduct (or have previously conducted, whichever is appropriate) all field inspections and tests as defined in the individual specification sections, installation checks, disinfection, hydrostatic tests, other preliminary or initial tests, and necessary corrections required, to demonstrate that individual components of the Work have been properly erected and found to operate in accordance with the Contract Documents, so that they can be utilized for their intended purposes.
- B. Remove all electrical jumpers, bypasses or other items connected to the equipment which are not intended to remain in the facility and are not required by the specifications. Demonstrate that each component is operating under its own control as designated.
- C. Confirm that all electrical circuits are energized in the automatic position, that valves and gates are set to their normal position and that the flow path through the Work is unobstructed.
- D. Equipment and electrical tagging shall be complete prior to initiation of function testing.
- E. All spare parts and special tools shall be delivered to CITY prior to initiation of function testing.
- F. Provide written supplier's certifications of installation confirming readiness for functional testing.

3.02 FUNCTIONAL TESTING

- A. General:
 - 1. Begin testing at a time mutually agreed upon by the CITY and/or ENGINEER, manufacturer's representative(s), and CONTRACTOR.

2. Notify in writing CITY, ENGINEER, and manufacturer's representative at least 14 days prior to scheduled date of functional tests.
3. Separate items of equipment demonstrated to function properly during subsystem testing may require no further functional test if documentation of subsystem testing is acceptable to ENGINEER.
4. Conduct functional test until each individual component item or system has achieved 2 continuous hours of satisfactory operation. Demonstrate all operational features and controls function during this period while in automatic modes.
5. If, in ENGINEER's opinion, each system meets the functional requirements specified, such system will be accepted as conforming for purposes of advancing to performance testing phase, if required. If, in ENGINEER's opinion, functional test results do not meet requirements specified, the systems will be considered as nonconforming.

3.03 SYSTEM PERFORMANCE TESTING

A. General:

1. The startup of each facility and performance testing is a highly complex operation requiring the combined technical expertise of the CONTRACTOR, suppliers, subcontractors, the ENGINEER, and the CITY. The CONTRACTOR shall provide the effective and advance coordination of all parties necessary for the successful startup.
2. System performance testing shall not commence until punch list items are adequately addressed to the ENGINEER's satisfaction, and the equipment or system meets functional tests specified.
3. All defects in materials or workmanship that appear during the system performance test shall be immediately corrected by the CONTRACTOR. Time lost for equipment repairs, wiring corrections, control point settings, or other reasons which actually interrupt the startup may, at the discretion of the ENGINEER, be justifiable cause for extending the system performance test Operation Period.
4. Should a significant interruption as defined previously in this Section, be incurred, the test shall be restarted from the beginning, unless the failure is of two hours or less in duration, or considered minor by the ENGINEER. The CONTRACTOR shall bear all costs associated with restarting the test period. Restart of the test period shall be solely at the ENGINEER's discretion.

B. System Performance Testing:

1. The duration of the system performance test shall be as defined in Article 1.02 of this Section, or as defined elsewhere in the Documents, whichever is longer.
2. The CONTRACTOR shall provide technical representatives of all equipment manufacturers, system suppliers, subcontractors, etc., for as-needed service to address mechanical malfunctions.

3. The CONTRACTOR shall furnish and coordinate the services of technical representatives of all equipment manufacturers to perform the testing services outlined in Contract Documents and the testing plan. The technical representatives of all equipment manufacturers shall perform startup testing and prepare test reports.
4. During the System Performance Testing, the CONTRACTOR shall assist the CITY in directing the CITY's personnel performing routine operating functions for the new facility.
5. The CONTRACTOR shall also be responsible for furnishing mechanics, labor, materials, and equipment that may be required to repair any malfunctions to equipment furnished and installed under the scope of this project.

3.04 O&M TRAINING

- A. The training period shall not begin until successful completion of all system Functional Testing. The training period may be concurrent with the System Performance Testing period, however, shall not be deemed complete or shall be considered interrupted if there is a significant interruption of the System Performance Testing. If a significant interruption occurs, training shall be repeated and/or continued, at the CITY's option, at the time that the Performance Testing restarts. Also, training shall not begin until all O&M Manuals, specified in the Section entitled "Submittals", have been accepted by the ENGINEER.
- B. During the training period the CONTRACTOR shall provide the services of an experienced representative of the supplier of each item of equipment (excluding minor items of equipment specifically exempted by the ENGINEER in writing), who shall visit the site and instruct the CITY's operating and maintenance personnel in correct operation and maintenance procedures. It is noted that training requirements are specified throughout the Contract Documents. The instruction shall demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment. Training shall include classroom and field/hands-on (with operational equipment) instructions. Training shall be provided only while the respective representative's equipment is fully operational. On-site instruction shall be given by qualified persons who have been made familiar in advance with the equipment and systems at the project site.
- C. Training shall be scheduled and coordinated by the CONTRACTOR. Training hours shall be arranged in writing with the CITY at least 14 days in advance of the scheduled training with a subsequent written confirmation at least 48 hours in advance.

SPARE PARTS INVENTORY

SUMMARY SHEET

EQUIPMENT NO. _____ DATE _____

LOCATION _____ REV. _____

NAME _____

ADDRESS _____

PHONE () _____

SPARE PARTS INVENTORY:

[illegible]

- END OF SECTION -

SECTION 01700 - PROJECT CLOSEOUT

PART 1 -- GENERAL

1.01 PROJECT CLOSEOUT

- A. As construction of the project enters the final stages of completion, the CONTRACTOR shall, in accordance with the requirements set forth in the Contract Documents, attend to or have already completed the following items:
 - 1. Scheduling start-up and initial operation.
 - 2. Correcting or replacing defective work, including completion of items previously overlooked or work which remains incomplete, all as evidenced by the CITY's "Punch" lists.
 - 3. Make final submittals.
 - 4. Attend to any other items listed herein or brought to the CONTRACTOR's attention by the CITY.

1.02 CLOSEOUT TIMETABLE

- A. The CONTRACTOR shall establish dates for equipment testing, acceptance periods, and instructional periods (as required under the Contract). Such dates shall be established not less than one week prior to beginning any of the foregoing items, to allow the CITY, the ENGINEER and their authorized representatives sufficient time to schedule attendance at such activities.

1.03 FINAL SUBMITTALS

- A. Before the acceptance of the project major milestones for substantial completion, the CONTRACTOR shall submit to the ENGINEER (or to the CITY if indicated) certain records, certifications, etc., which are specified elsewhere in the Contract Documents. Missing, incomplete or unacceptable items, as determined by the ENGINEER, shall indicate non-compliance with substantial completion major milestone dates. A partial list of such items appears below, but it shall be the CONTRACTOR'S responsibility to submit any other items which are required in the Contract Documents:
 - 1. Written Test results of project components.
 - 2. Performance affidavits for equipment.
 - 3. Operation and Maintenance Manuals for equipment.
 - 4. Record Drawings: During the entire construction operation, the CONTRACTOR shall maintain records of all deviations from the Drawings and Specifications and shall prepare record drawings showing correctly and accurately all changes and deviations from the Work made during construction to reflect the Work as it was actually constructed. These drawings shall conform to recognized standards of

drafting, shall be neat, legible and on mylar or other reproducible material acceptable to the ENGINEER.

5. Written guarantees, where required.
6. Certificates of inspection and acceptance by local governing agencies having jurisdiction.
7. Releases from all parties who are entitled to claims against the subject project, property, or improvement pursuant to the provisions of law.

1.04 PUNCH LISTS

- A. Final cleaning and repairing shall be scheduled upon completion of the project.
- B. The ENGINEER will make his final inspection whenever the CONTRACTOR has notified the ENGINEER that the work is ready for the inspection. Any work not found acceptable and requiring cleaning, repair and/or replacement will be noted on the "Punch" list. Work that has been inspected and accepted by the ENGINEER shall be maintained by the CONTRACTOR, until final acceptance of the entire project.
- C. Whenever the CONTRACTOR has completed the items on the punch list, he shall again notify the ENGINEER that it is ready for final inspection. This procedure will continue until the entire project is accepted by the ENGINEER. The "Final Payment" will not be processed until the entire project has been accepted by the ENGINEER and all of the requirements in previous Article 1.03 "Final Submittals" have been satisfied.

1.05 MAINTENANCE AND GUARANTEE

- A. The CONTRACTOR shall comply with all maintenance and guarantee requirements of the Contract Documents.
- B. Replacement of earth fill or backfill, where it has settled below the required finish elevations, shall be considered as a part of such required repair work, and any repair or resurfacing constructed by the CONTRACTOR which becomes necessary by reason of such settlement shall likewise be considered as a part of such required repair work unless the CONTRACTOR shall have obtained a statement in writing from the affected private CITY or public agency releasing the CITY from further responsibility in connection with such repair or resurfacing.
- C. The CONTRACTOR shall make all repairs and replacements promptly upon receipt of written order from the CITY. If the CONTRACTOR fails to make such repairs or replacements promptly, the CITY reserves the right to do the Work and the CONTRACTOR and his surety shall be liable to the CITY for the cost thereof.

1.06 TOUCH-UP AND REPAIR

- A. The CONTRACTOR shall touch-up and repair damage to all field painted and factory finished equipment. Touch-up of equipment panels, etc., shall match as nearly as possible the original finish. If in the opinion of the ENGINEER the touch-up work is not

satisfactory, the CONTRACTOR shall repaint the item. CONTRACTOR shall also furnish additional paint as defined in Section 09900.

1.07 FINAL CLEANUP

- A. The CONTRACTOR shall promptly remove from the vicinity of the completed Work, all rubbish, unused materials, concrete forms, construction equipment, and temporary structures and facilities used during construction. Final acceptance of the Work by the CITY will be withheld until the CONTRACTOR has satisfactorily complied with the foregoing requirements for final cleanup of the project site.

PART 2 -- PRODUCTS (Not Used)

PART 3 -- EXECUTION (Not Used)

- END OF SECTION -

DIVISION 2 – SITE WORK

SECTION 02050 - DEMOLITION

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The CONTRACTOR shall remove and dispose of or salvage any existing structure, piping, conduits, electrical equipment, mechanical equipment, or appurtenances or portions thereof, as shown on the Drawings or required to complete the project.
- B. All materials designated for disposal shall, when released by the ENGINEER, become the CONTRACTOR's property and shall be removed from the site and disposed of by the CONTRACTOR.
- C. All materials designated to be salvaged shall be carefully removed and moved to a city-designated location within the City of Hollywood.

1.02 SUBMITTALS

- A. The CONTRACTOR shall submit for review, in accordance with Section entitled "Submittals" the proposed methods, equipment and operation sequence. Include coordination for shut-off, temporary services, continuation of service and other applicable items to ensure no interruption of operations except as herein before specified.

1.03 JOB CONDITIONS

- A. Protection: The CONTRACTOR shall execute the demolition and removal work to prevent damage or injury to structures, occupants thereof and adjacent features which might result from falling debris or other causes, and so as not to interfere with the use, and free and safe passage to and from adjacent structures.
- B. Use of Explosives: The use of explosives is strictly prohibited on this project
- C. Closing or obstructing of roadways adjacent to the work by the placement or storage of materials will not be permitted. All operations shall be conducted with a minimum interference to traffic on these ways.
- D. The CONTRACTOR shall repair damage done to facilities to remain, or any property belonging to the CITY.
- E. Scheduling: The CONTRACTOR shall carry out his operations so as to avoid interference with operations and work in the existing facilities.
- F. Notification: At least 48 hours prior to commencement of a demolition or removal, the CONTRACTOR shall notify the CITY in writing of his proposed removal schedule. No removals shall be started until the schedule is acceptable to the CITY.

1.04 PRE-DEMOLITION ASBESTOS SURVEY – NOT REQUIRED

- A. The CONTRACTOR is responsible for performing a Pre-Demolition Asbestos survey prior to the commencement of demolition activities at the site. This survey must be completed by a Florida licensed Asbestos Consultant. A copy of the survey shall be provided to the ENGINEER and CITY for informational purposes only.
- B. The CONTRACTOR is required to procure all permits related to demolition prior to the commencement of demolition activities at the site.

1.05 DUST CONTROL

- A. The CONTRACTOR shall use temporary enclosures and other suitable methods to limit the amount of dust and dirt rising and scattering in the air to the lowest practical level. Existing electrical and mechanical equipment to remain shall be protected from damage, dust, and debris.

PART 2 – PRODUCTS

(NOT USED)

PART 3 -- EXECUTION

3.01 GENERAL

- A. Prior to commencing work, the CONTRACTOR shall check all underground and exposed existing utility and process piping and all equipment in any way associated or in the proximity to the items to be removed and shall verify that the piping is inactive (abandoned) and that electric power to equipment, lighting, controls, etc., has been permanently disconnected. Active services shall be brought to the attention of the CITY for proper action.
- B. The CONTRACTOR shall remove all equipment and accessories in a workmanlike manner and shall take all necessary precautions to avoid damaging existing equipment, piping, and structure which are to be retained. Damages shall be repaired or replaced at the expense of the CONTRACTOR.
- C. The CONTRACTOR shall proceed with the removal of the structures, equipment, piping, and appurtenances in a sequence designed to maintain the facilities in continuous operation.
- D. All supports, pedestals, and anchors shall be removed with the equipment structures and piping unless otherwise specified or required. Concrete bases, anchor bolts, and other supports shall be removed in their entirety; and the recesses shall be patched to match the adjacent areas. Superstructure wall and roof openings shall be closed; damaged surfaces shall be patched to match the adjacent areas, as specified under applicable sections of these Specifications, and as shown on the Drawings, or as indicated by the ENGINEER. Wall sleeves and castings shall be cleared of extraneous materials and filled with non-shrink grout as recommended by manufacturer for watertightness required. All openings in concrete shall be closed in a manner meeting the

requirements of the appropriate sections of these Specifications, as shown on the Drawings, and as acceptable to the ENGINEER.

3.02 UNAUTHORIZED REMOVAL

- A. Any equipment, piping, and appurtenances removed without proper authorization, shall be replaced to the satisfaction of the ENGINEER at no cost to the CITY.

3.03 SALVAGED ITEMS

- A. Items to be salvaged as shown on the plans shall be tagged and shall remain the property of the CITY. The CONTRACTOR shall carefully move salvaged equipment to a CITY-designated location at the Southern Regional Wastewater Treatment Plant. Items to be salvaged include:

1. Existing variable frequency drives for RAS pumps, typical of three
2. Existing RAS pumps and motors
3. Square D manufactured sections of Motor Control Center
4. Transformers
5. All other metal materials

3.04 DEMOLITION

- A. All materials and equipment shown on the Drawings to be removed or demolished shall become the property of the CONTRACTOR, with the exception of items tagged to be salvaged and metal items tagged for recycling. Prior to removal of any existing equipment or piping from the site of work, the CONTRACTOR shall ascertain from the ENGINEER whether or not the particular item or items are to be salvaged or recycled. The CONTRACTOR shall dispose of all demolition materials, equipment, debris and all other items off the project site and in conformance with all existing applicable laws and regulations.

3.05 STRUCTURAL REMOVALS

- A. The CONTRACTOR shall remove structures to the lines and grades shown, unless otherwise indicated by the ENGINEER.
- B. All wood, concrete, brick, tile, concrete block, roofing materials, reinforcement, structural or miscellaneous metals, plaster, wire mesh and other items contained in or upon the structure shall be removed and taken from the project site. These items shall not be used in backfill.
- C. Finishes: After removal of parts or all of masonry walls, slabs and like work, which tie into new work or existing work, the point of junction shall be neatly repaired so as to leave only finished edges and surface exposed. The jambs, sills and heads of any new windows, passageways, doors or other openings cut into the new work or existing work shall be dressed with new masonry, concrete or metal to provide a smooth, finished appearance.

- D. Anchoring: Where new anchoring materials, including bolts, nuts, hangers, welds and reinforcing steel, are required to attach new work to the existing work, they shall be included under this Section, except where specified elsewhere.

3.06 MECHANICAL REMOVALS

- A. General: Mechanical removals shall consist of dismantling and removing of existing piping, equipment and other appurtenances as shown or required for the completion of the work. It shall include cutting, capping and plugging as required.
- B. Wherever piping is to be removed, adjacent pipe headers that are to remain in service shall be blanked off or plugged and then anchored in an acceptable manner.

3.07 ELECTRICAL REMOVALS

- A. General: Electrical removals shall consist of the removal of conduits and wires, and miscellaneous electrical equipment all as shown, specified or required to perform the work. All existing electrical equipment to be removed shall be removed with such care as maybe required to prevent unnecessary damage, to keep existing systems in operation and to keep the integrity of the grounding systems.

3.08 REPAIR WORK

- A. Certain areas of existing structures, piping, conduits, and the like will be affected by work necessary to complete modifications under this Contract. The CONTRACTOR shall be responsible to rehabilitate those areas affected by its construction activities.
- B. Where new rectangular openings are to be installed in concrete or concrete masonry walls or floors, the CONTRACTOR shall score the edges of each opening (both sides of wall or elevated slab) by saw cutting clean straight lines to a minimum depth of one inch and then chipping out the concrete. Alternately, the opening can be formed by saw cutting completely through the slab or wall. Saw cuts deeper than one inch (or the depth of cover over existing reinforcing steel, whichever is less) shall not be allowed to extend beyond the limits of the opening. Corners shall be made square and true by a combination of core drilling, chipping, or grinding. All necessary precautions shall be taken during removal of concrete to prevent debris from falling and damaging adjacent equipment or piping. Saw cuts allowed to extend beyond the opening shall be repaired by filling with nonshrink grout. The concrete around any exposed reinforcement steel shall be chipped back and exposed reinforcement steel cut a minimum of 1-1/2 inches from the finished face of the new opening. The inside face of the new opening shall be grouted to fill any voids and cover the exposed aggregate and shall be trowel-finished to provide a plumb and square opening.
- C. Where new conduit or piping is to be installed through existing concrete walls, the CONTRACTOR shall accurately position and core-drill openings. Openings shall be adequately sized to allow alignment of piping or conduit and fittings without deflection and to provide adequate clearance for satisfactory packing in the annular space between the piping or conduit and the core drilling opening as shown on the Drawings.
- D. Where new piping is to be connected to existing piping, the existing piping shall be cut square and the ends properly prepared for the connection shown on the drawings. Any

damage to the lining and coating of the existing piping shall be repaired by the CONTRACTOR.

- E. Where existing equipment, equipment pads and bases, piping, piping supports, handrail, electrical panels and devices, conduits, and associated appurtenances are removed, the CONTRACTOR shall rehabilitate the affected area such that little or no evidence of the previous installation remains. Openings in concrete floors, walls, and ceiling from piping, conduit, fastener penetrations, etc., shall be filled with nonshrink grout and finished to match the adjacent area. Concrete pads and bases for equipment and supports shall be removed by chipping away concrete and cutting any exposed reinforced steel and anchor bolts a minimum of 1-1/2 inches below finished grade. The area of concrete to be rehabilitated shall be scored by saw cutting clean, straight lines to a minimum depth of 1-1/2 inches, and all concrete within the scored lines removed to a minimum depth of 1-1/2 inches. The area within the scored lines shall be patched with nonshrink grout to match the adjacent grade and finish. Unless otherwise shown, abandoned connections to piping and conduits shall be terminated with blind flanges, caps, and plugs suited for the material, type, and service of the pipe or conduit. Walls shall be painted in accordance with requirements set forth in Section 09900 entitled "Painting".
- F. Where existing structural steel members are removed or modified, the surface of the remaining existing steel members damaged by construction activities shall be repaired. The affected areas shall be surface prepared and coated in accordance with Section 09900 entitled "Painting".
- G. Disposal of Debris
 - 1. All debris, materials, piping, and miscellaneous waste products from the work described in this section shall be removed from the project as soon as possible. They shall be disposed of in accordance with applicable federal, state, and local regulations. The CONTRACTOR is responsible for determining these regulations and shall bear all costs or retain any profit associated with disposal of these items.

3.09 CLEANUP

- A. The CONTRACTOR shall remove from the project site all debris resulting from the demolition and removal operations as it accumulates. Upon completion of the demolition work, all materials, equipment, waste and debris of every sort shall be removed and the premises shall be left clean, neat and orderly.

- END OF SECTION -

SECTION 02210 - SITE GRADING

PART 1 -- GENERAL

1.01 WORK INCLUDED

- A. The CONTRACTOR shall perform grading Work within the limits, elevations and grades indicated on the Drawings and as specified herein.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Excavation and Backfill for Utilities
- B. Concrete Pavement, Curb and Sidewalks

1.03 QUALITY CONTROL

- A. The site shall be graded to the required elevations. Spot elevations are shown on the Drawings and the finished surfaces shall be uniformly sloped between these locations.
- B. Suitable excavated material shall be used in the formation of embankments as shown on the Drawings. The CONTRACTOR shall provide all additional fill material required to complete the embankments.

PART 2 -- PRODUCTS

2.01 FILL

- A. Fill used for site grading shall be noncohesive, nonplastic, granular mixture of local sand and limerock, shall be free from vegetation, organic material or muck and shall contain not more than 8 percent material by weight which passes the No. 200 sieve. Broken concrete shall not be used in the fill. Fill material containing limerock shall have sufficient sand to fill the voids in the limerock, and no individual rocks or pieces of hard material that will not pass a 6-inch diameter ring shall be used in the fill; except that the upper 4-inches of all backfill or fills shall not contain any rock or hard material that will not pass a 3-inch diameter ring. All fill material shall be provided by the CONTRACTOR from any excess suitable on-site material or from off site sources, all subject to review and acceptance by the ENGINEER prior to use. The CONTRACTOR shall be responsible for determining the volume of material required for the site.

PART 3 -- EXECUTION

3.01 PREPARATION

- A. CONTRACTOR shall establish and identify required lines, levels, contours, and datum.
- B. Bench marks, monuments, and other reference points shall be maintained and re-established if disturbed at no cost to the CITY.

- C. Before the start of grading, CONTRACTOR shall establish the location and extent of utilities in the work area. CONTRACTOR shall notify utilities to remove and relocate lines which are in the way of construction.
- D. CONTRACTOR shall maintain, protect, reroute, or extend as required the utilities which are to remain in the work area.

3.02 REMOVAL OF TOPSOIL

- A. CONTRACTOR shall strip topsoil of horticultural value from areas of construction and stockpile said material separately from fill material.
- B. Topsoil shall not be mixed with subsoil.
- C. Topsoil shall not be stripped when wet.
- D. Heavy equipment shall not be driven over stockpiled topsoil.

3.03 GRADING AND COMPACTION

- A. Fill material shall be placed in lifts not to exceed 8-inches and compacted to a density of not less than 95 percent of maximum density at optimum moisture as determined by ASTM D 1557. Fill material shall be within plus or minus 2 percentage points of optimum moisture content. The minimum density acceptable at any location within the pavement subgrade shall be as specified in Section 02510 – Asphaltic Concrete Pavement.

3.04 FINE GRADING

- A. After structures, bases and pavements are completed and the yard piping trenches backfilled, the disturbed areas of the site shall be fine graded. All construction debris, regardless of size, shall be removed. The completed surface shall be shaped and sloped to drain away from the structures. The completed surface shall be within 0.1 foot of the elevations shown on the Drawings, unless otherwise accepted by the ENGINEER. Minor adjustments to line and grade may be required as the Work progresses in order to satisfy field conditions.

3.05 SURPLUS MATERIAL

- A. CONTRACTOR shall remove and dispose of surplus materials at no cost to CITY.

- END OF SECTION -

SECTION 02222 - EXCAVATION AND BACKFILL FOR UTILITIES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. Excavate, grade and backfill as required for underground piping systems and appurtenances as shown on the Drawings and specified herein.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Piping

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Codes: All codes, as referenced herein, are specified in Section 01090, "Reference Standards".

- B. Commercial Standards:

ASTM D 422	Method for Particle-Size Analysis of Soils.
ASTM D 698	Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft·lbf/ft ³ (600 kN·m/m ³
ASTM D 1556	Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.
ASTM D 1557	Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft·lbf/ft ³ (2,700 kN·m/m ³
ASTM D 2419	Test Method for Sand Equivalent Value of Soils and Fine Aggregate.
ASTM D 2922	Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

1.04 SUBMITTALS

- A. General: Submit information and samples to the CITY for review as specified herein in accordance with the Section entitled "Submittals".
- B. Dewatering: The CONTRACTOR shall submit to the CITY its proposed methods of handling trench water and the locations at which the water will be disposed of. Methods shall be acceptable to the CITY before starting the excavation.
- C. Bedding and Backfill Materials: The CONTRACTOR shall notify the CITY of the off-site sources of bedding and backfill materials.

1. Submit to the CITY a representative sample weighing approximately 25 lbs. The sample shall be delivered to a location at the work site determined by the CITY.
 2. The CONTRACTOR shall notify the CITY in writing of the sources of each material at least ten calendar days prior to the anticipated use of the materials.
- D. Sheeting System: Drawings of the sheeting system and design computations shall be submitted to the CITY; 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 CITY is of the opinion that at any point sufficient or proper supports have not been provided, it may order additional supports put in at the CONTRACTOR's expense.
- E. 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 CITY before commencing the work.

1.05 QUALITY CONTROL

- A. An independent testing laboratory will be retained by the CITY to do appropriate testing as described in Section 01400, "Testing and Inspection". The CONTRACTOR shall schedule its work so as to permit a reasonable time for testing before placing succeeding lifts and shall keep the laboratory informed of his progress. A minimum of 48 hours of notice shall be provided to the testing laboratory to mobilize its activities.

1.06 SUBSURFACE INFORMATION

- A. Separate geotechnical reports are available upon request. No part of these reports shall be construed as requirements of the Contract.
- B. The CITY will not assume responsibility for variations of sub-soil quality or conditions at locations other than places shown and at the time the geotechnical investigations were made. The CONTRACTOR shall examine the site and review the available geotechnical reports or undertake its own subsurface investigation prior to submitting its bid, taking into consideration all conditions that may affect its work.

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 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.

1.07 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 as noted in the Contract front-end documents.
- B. The CONTRACTOR acknowledges that this cost is included in the applicable items of the Proposal and Contract and in the Grand Total Bid and Contract Price.
- C. The CONTRACTOR is, and the CITY is 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 any and all requirements of Florida Statute Section 553.60 et. seq. cited as the "Trench Safety Act". The CONTRACTOR is, and the CITY is not, responsible to determine if any safety or safety related standards apply to the project, including but not limited to, the "Trench Safety Act".

1.08 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 MATERIALS

- A. General: Materials shall be furnished as required from on-site excavations or from acceptable off-site sources as required. The CONTRACTOR shall notify the CITY in writing of the sources of each material at least ten calendar days prior to the anticipated use of the materials.

2.02 BEDDING

- A. Pipe Bedding: In general, clean sandy materials excavated from the utility trench, that is free from organics, clay and construction debris, can be used as pipe bedding when construction is in a dry condition and when the bedding is not sided by muck. Pipe bedding material shall be able to pass through a 3/4-inch sieve. Separation of suitable material for pipe bedding from other material shall be made during the excavation.
- B. Sand shall be used for all copper and other service lines.
- C. In the case of a "dry" installation, sand shall be used for PVC and ductile iron pipe where the bottom of the trench is located in the limestone zone.
- D. In the case of a "wet" installation, pearock shall be used for PVC and ductile iron pipe where the bottom of the trench is located in the limestone zone.
- E. Precast concrete items shall use crushed stone.

2.03 PEAROCK

- A. Pearock shall consist of hard, durable particles of proper size and gradation, and shall be free from organic material, wood, trash, sand, loam, clay, excess fines, and other deleterious materials. Pearock shall conform to the requirements of ASTM C 33, Size Number 8, graded within the following limits:

<u>Sieve Size</u>	<u>Percent Finer by Weight</u>
1/2 inch	100
3/8 inch	85 to 100
No. 4	10 to 30
No. 8	0 to 10
No. 16	0 to 5

2.04 CRUSHED STONE (3/4-INCH ROCK)

- A. Crushed stone shall consist of hard, durable, subangular particles of proper size and gradation, and shall be free from organic material, wood, trash, sand, loam, clay, excess fines, and other deleterious materials. Crushed stone shall conform to the requirements of ASTM C 33, Size Number 57, graded within the following limits:

<u>Sieve Size</u>	<u>Percent Finer by Weight</u>
1 1/2 inch	100
1 inch	95 to 100
1/2 inch	25 to 60
No. 4	0 to 10
No. 8	0 to 5

2.05 SAND

- A. Sand shall be used for bedding polyvinyl chloride, fiberglass, HDPE and other plastic pipe when installed under dry trench conditions unless indicated otherwise on the Drawings. Sand shall be graded sand with 100 percent passing a 3/8-inch sieve and not more than 5 percent passing a No. 200 sieve.

2.06 SELECT BACKFILL

- A. Select Backfill: 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.
- B. At locations where subsurface preparations for structures have been performed under this or other previous construction contracts, clean excavated material (structural fill) may be used as select backfill. Any excess fill shall be disposed of off-site by the CONTRACTOR.

2.07 GENERAL BACKFILL

- A. General backfill (for grading applications) or "fill" shall be placed above the select backfill. General backfill shall be as specified in Section 02210 – Site Grading.
- B. General backfill used under roadways shall be compatible with the materials and compaction specified under the Sections entitled "Asphaltic Concrete Pavement" and "Concrete Pavement, Curbs and Sidewalks".

PART 3 -- EXECUTION

3.01 EXCAVATION

- A. The CONTRACTOR shall perform all excavation of every description and of whatever substance encountered, to the dimensions, grades and depths shown on the Drawings, or as required for a proper installation. All excavations shall be made by open cut in accordance with the Trench Safety Act, except where noted otherwise on the Drawings. All existing utilities such as pipes, poles and structures shall be carefully located, supported and protected from injury; in case of damage, they shall be restored at the CONTRACTOR's expense.
- B. Pipe trenches for piping shall be excavated to a width within the limits of the top of the pipe and the trench bottom so as to provide a clearance on each side of the pipe barrel, measured to the face of the excavation, or sheeting if used, of 8 inches to 12 inches. Where the pipe size exceeds 12 inches, the clearance shall be from 12 inches to 18 inches unless otherwise indicated on the Drawings. All pipe trenches shall be excavated to a level where suitable material is reached, a minimum of 8 inches below the excavated depth that will allow for a minimum of 36-inches of covering unless otherwise indicated on the Drawings. Excavation depths in other types of materials and conditions shall be made as hereinafter specified.

- C. In areas where trench widths are not limited by right-of-way and/or easement widths, property line restrictions, existing adjacent improvements, including pavements, structures and other utilities, and maintenance of traffic, the trench sides may be sloped to a stable angle of repose of the excavated material but only from a point one foot above the crown of the pipe. A substantially and safely constructed movable shield, "box" or "mule" may be used in place of sheeting when the trench is opened immediately ahead of the shield and closed immediately behind the shield as pipe laying proceeds inside the shield.
- D. Ladders or steps shall be provided for and used by Workmen to enter and leave trenches, in accordance with OSHA requirements.
- E. Excavation for appurtenances shall be sufficient to provide a clearance between their outer surfaces and the face of the excavation or sheeting, if used, of not less than 12 inches.
- F. Excavated unsuitable material shall be removed from the site and disposed of by the CONTRACTOR. Materials removed from the trenches shall be stored in such a manner that will not interfere unduly with any on-site operations, traffic on public roadways and sidewalks and shall not be placed on private property. In congested areas, such materials which cannot be stored adjacent to the trench or used immediately as backfill shall be removed to other convenient places of storage acceptable to the CITY at the CONTRACTOR's expense.
- G. Excavated material that is suitable for use as backfill shall be used in areas where sufficient material is not available from the excavation. Suitable material in excess of backfill requirements shall be either used on the site as directed by the CITY or disposed of by the CONTRACTOR.
- H. Barriers shall be placed at excavations in accordance with OSHA requirements.

3.02 SHEETING AND BRACING

- A. The CONTRACTOR shall furnish, place and maintain sheeting and bracing to support sides of the excavation as necessary to provide safe working conditions in accordance with OSHA requirements, and to protect pipes, structures and other Work from possible damage. Where wood sheeting or certain designs of steel sheeting are used, the sheeting shall be cut off at a level of 2 feet above the top of the installed pipe and that portion below the level shall be left in place. If interlocking steel sheeting is used, it may be removed providing removal can be accomplished without disturbing the bedding, pipe or alignment of the pipe. Any damage to the pipe bedding, pipe or alignment of the constructed utility caused by the removal of sheeting shall be cause for rejection of the affected portion of the work. The CITY may permit sheeting to be left in place at the request and expense of the CONTRACTOR, or the CITY may order him in writing to leave in place, for the preventing of damage to structures or property. Payment for sheeting ordered to remain in place shall be paid for at a negotiated price.
- B. If the CITY is of the opinion that at any point sufficient or proper supports have not been provided, he may order additional supports put in at the CONTRACTOR's expense. The CONTRACTOR shall be responsible for the adequacy of all sheeting used and for

all damage resulting from sheeting and bracing failure or from placing, maintaining and removing it.

3.03 REMOVAL OF WATER

- A. General: It is a basic requirement of these Specifications unless otherwise authorized per Article 3.10 that excavations shall be free from water before pipe or structures are installed.
- B. The CONTRACTOR shall provide pumps, and other appurtenant equipment necessary to remove and maintain water at such a level as to permit construction in a dry condition. The CONTRACTOR shall continue dewatering operations until backfilling has progressed to a sufficient depth over the pipe to prevent flotation or movement of the pipe in the trench or so that it is above the water table. If at any point during the dewatering operation it is determined that fine material is being removed from the excavation sidewalls, the dewatering operation shall be stopped. If any of the subgrade or underlying material is disturbed by movement of groundwater, surface water, or any other reason, it shall be replaced at the CONTRACTOR's expense with crushed stone or gravel.
- C. The CONTRACTOR shall use dewatering systems that include automatic starting devices, and standby pumps that will ensure continuous dewatering in the event of an outage of one or more pumps.
- D. Disposal: Water from the trenches and excavation shall be disposed of in such a manner as will not cause injury to public health, to public or private property, to the Work completed or in progress, to the surface of the streets, cause any interference with the use of the same by the public, or cause pollution of any waterway or stream. The CONTRACTOR shall submit his proposed methods of handling trench water and locations at which the water will be disposed of to the CITY for review and shall receive acceptance before starting the excavation. Disposal to any surface water body will require silt screens to prevent any degradation in the water body. The CONTRACTOR shall have responsibility for acquiring all necessary permits for disposal.

3.04 TRENCH STABILIZATION

- A. No claim for extras, or additional payment will be considered for cost incurred in the stabilization of trench bottoms which are rendered soft or unstable as a result of construction methods, such as improper or inadequate sheeting, dewatering or other causes. In no event shall pipe be installed when such conditions exist and the CONTRACTOR shall correct such conditions so as to provide proper bedding or foundations for the proposed installation at no additional cost to the CITY before placing the pipe or structures.

3.05 PIPE BEDDING

- A. Pipe trenches shall be excavated as described in Article 3.01. The resulting excavation shall be backfilled with acceptable pipe bedding material, up to the level of the centerline of the proposed pipe barrel. This backfill shall be tamped and compacted to provide a proper bedding for the pipe and shall then be shaped to receive the pipe.

Bedding shall be provided under the branch of all fittings to furnish adequate support and bearing under the fitting.

- B. Any over excavation below the levels required for installation of the pipe shall be backfilled with acceptable bedding material, tamped, compacted and shaped to provide proper support for the proposed pipe, at the CONTRACTOR's expense.

3.06 BACKFILL

- A. Pipeline trenches shall be backfilled to a level 12 inches above the top of the pipe with select backfill. When placed in the dry, such material shall be placed in 6-inch layers, each compacted to the densities specified in Article 3.07. Only hand operated mechanical compacting equipment shall be used within six inches of the installed pipe.
- B. After the initial portion of backfill has been placed as specified above, and after all excess water has completely drained from the trench, backfilling of the remainder of the trench may proceed. The remainder of the backfill shall be selected material obtained from the excavation and shall be placed in horizontal layers, the depth of which shall not exceed the ability of the compaction equipment employed, and in no event shall exceed a depth of 9 inches. Each layer shall be moistened, tamped, puddled, rolled or compacted to the densities specified in Article 3.07.
- C. Any excavation below the levels required for the proper construction of manholes or vaults shall be filled with Class B concrete. The use of earth, rock, sand or other materials for this purpose will not be permitted.

3.07 COMPACTION AND DENSITIES

- A. Compaction of backfill shall be 98 percent of the maximum density where the trench is located under structures or paved areas, and 95 percent of the maximum density elsewhere. More thorough compaction may be required when Work is performed in other regulatory agencies jurisdictions, such as the FDOT. Methods of control and testing of backfill construction are:
 - 1. Maximum density of the material in trenches shall be determined by ASTM D 1557.
 - 2. Field density of the backfill material in place shall be determined by ASTM D 1556 or D 2922.
- B. Testing: Laboratory and field density tests, which in the opinion of the CITY are necessary to establish compliance with the compaction requirements of these Specifications, shall be ordered by the CITY. The CONTRACTOR shall coordinate and cooperate with the testing laboratory. The testing program will be implemented by the CITY establishing depths and locations of tests. Modifications to the program will be made as job conditions change.
- C. Trench backfill which does not comply with the specified densities, as indicated by such tests, shall be reworked and recompacted until the required compaction is secured, at no additional cost to the CITY. The costs for retesting such Work shall be paid for by the CONTRACTOR.

3.08 ADDITIONAL EXCAVATION AND BACKFILL

- A. Where organic material, such as roots, muck, or other vegetable matter, or other material which, in the opinion of the CITY, will result in unsatisfactory foundation conditions, is encountered below the level of the proposed pipe bedding material, it shall be removed to a depth of two feet below the outside bottom of the pipe or to a greater depths as directed by the CITY and removed from the site. Sheeting shall be installed if necessary to maintain pipe trenches within the limits identified by the CITY. The resulting excavation shall be backfilled with suitable backfill material, placed in 12-inch layers, tamped and compacted up to the level of the bottom of the proposed pipe bedding material. Sufficient compaction of this material shall be performed to protect the proposed pipe against settlement. Lean concrete may be used in lieu of backfill when pipe installation is in the wet or at the CONTRACTOR's option. Construction shall then proceed in accordance with the provisions of Article 3.05 "Pipe Bedding".
- B. Additional excavation (more than two feet below the pipe) shall be performed when ordered by the CITY. Where organic or other material is encountered in the excavation, the CONTRACTOR shall bring the condition to the attention of the CITY and obtain his determination as to whether or not the material will require removal, prior to preparing the pipe bedding. The excavation of material up to a depth of two feet below the outside bottom is an incidental item of construction and the Work shall be done at no additional cost to the CITY. Where ordered by the CITY, excavation greater than two feet below the pipe and additional backfill will be compensated by the CITY.

3.09 FINE GRADING

- A. After piping trenches backfilled, the disturbed areas of the site shall be fine graded. Any lumber, undesirable materials and rocks larger than the 3-inch size shall be removed from the surface. The completed surface shall be to the preconstruction elevation unless otherwise directed by the CITY. Minor adjustments to line and grade may be required as the work progresses in order to satisfy field conditions.

3.10 ALTERNATE METHOD OF CONSTRUCTION

- A. Use of This Method: A combination of conditions in the substrate, water table, or method of disposal may be encountered during the course of the work which makes dewatering impossible, or only possible through the use of unusual methods, the cost of which is excessive. When such conditions are encountered, but only after all reasonable means (pumps, well points, etc.) to dewater the excavation have been employed without success, the CONTRACTOR, may request to employ the following Alternate Method of Construction. The concurrence of the CITY shall be obtained in writing and shall limit the use of the alternate method of construction to such specific portions of the Work as the CITY shall determine.
- B. The requirements set forth in other sections of these Specifications shall establish the required standards of construction quality for this work. Use of the alternate method of construction described hereinafter shall in no way be construed as relieving the CONTRACTOR of the work. No additional payment will be made to the CONTRACTOR for excavation, backfill, sheeting or any cost incurred for Work or materials, or any other

costs incurred as a result of the use of this alternate method of construction. The prices established in the Proposal shall be for full payment for the various items of work.

- C. Subject to all the requirements stated herein, including written acceptance of the CITY, construction will be permitted in accordance with the following specifications. All requirements of these Specifications shall apply to this construction unless otherwise specifically modified herein.
- D. Removal of Water: The installation of pipe and appurtenances under water will be permitted and the requirements of Article 3.03 will be waived.
- E. Excavation shall be performed in accordance with Article 3.01.
- F. Pipe Bedding: Pipe bedding shall be placed from 6 inches below the outside bottom of the proposed pipe barrel up to the centerline of the pipe barrel. The bedding material shall be pearock as specified in Article 2.03 "Pearock". Limerock screenings, sand or other fine organic material shall not be used.
- G. The bedding material shall be placed and then be shaped to receive the pipe at the intended elevation. Bedding shall be provided under the branch of all fittings to furnish adequate support and bearing under the fitting.
- H. Backfill: After the pipe is installed, backfilling shall proceed in accordance with the provisions of Article 3.06 "Backfill" and 3.07 "Compaction and Densities". Select backfill material shall be used to backfill around the pipe and to a level one foot above the crown of the pipe. Under no circumstances will material other than select backfill or specified pipe bedding material be considered satisfactory for this purpose.
- I. If the Alternate Method of Construction is used, all backfill material, including specified pipe bedding material, shall be carefully lifted into the trench and not released to fall freely therein until the bucket or container is at or just above water level. Under no circumstances will backfill material be dumped or pushed into the trenches containing water. Below existing water level, the backfill material shall be carefully rammed into place in uniform layers, of equal depth on each side of the pipe, up to the water level. Above the water level, backfill material shall be placed and compacted for normal backfill as previously specified.

3.09 RESTORATION OF EXISTING SURFACES

- A. Restore all grassed areas disturbed by the trenching operations by resodding in accordance with the Contract Documents.
- B. Restore all asphaltic concrete pavement areas disturbed by the trenching operations in accordance with the Section entitled "Asphaltic Concrete Pavement."
- C. Restore all concrete pavement, curbs, and sidewalks disturbed by the trenching operations in accordance with the Section entitled "Concrete Pavement, Curbs and Sidewalks."

- END OF SECTION -

SECTION 02224 - EXCAVATION AND BACKFILL FOR STRUCTURES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. This section consists of excavation, backfill and compaction under structures required for a complete installation as shown on the Drawings and specified herein.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 03300 - Cast-In-Place Concrete

1.03 DEFINITIONS

- A. Maximum Density: Maximum weight in pounds per cubic foot of a specific material.
- B. Optimum Moisture: Percentage of water in a specific material at maximum density.

1.04 SUBMITTALS

- A. General: Submit information and samples as specified herein to the ENGINEER for review in accordance with Section 01300 - Submittals.
- B. Sheeting System: Drawings of the sheeting system and design computations shall be submitted to the ENGINEER prior to commencement of construction activity at the affected work. 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 supports have not been provided, it may order additional supports to be put in at the CONTRACTOR's expense.
- C. Dewatering: The CONTRACTOR shall submit its proposed methods of handling trench water and the locations at which the water will be disposed of. The CONTRACTOR retains unit responsibility for requiring all necessary permits and meeting all local regulatory agency requirements prior to the start of the excavation.
- D. Bedding and Backfill Materials: The CONTRACTOR shall notify the ENGINEER of the off-site sources of bedding and backfill materials and submit to the ENGINEER the grain size distribution, moisture retaining properties of the proposed fill.
- E. Required Procedures:
 - 1. Obtain all necessary permits for its dewatering activities from the jurisdictional agencies including, but not limited to the South Florida Water Management District, as applicable. Submit copies of permits to the ENGINEER.

1.05 QUALITY CONTROL

- A. An independent testing laboratory will be retained by the CITY to do appropriate testing as described in Section 01400 – Testing and Inspection. The CONTRACTOR shall schedule its Work so as to permit a reasonable time for testing before placing succeeding lifts and shall keep the laboratory informed of its progress. A minimum of 48 hours of notice shall be provided to the testing laboratory to mobilize its activities.

1.06 SUBSURFACE INFORMATION

- A. Separate geotechnical reports are available upon request. No part of these reports shall be construed as requirements of the Contract.
- B. The CITY will not assume responsibility for variations of sub-soil quality or conditions at locations other than places shown and at the time the geotechnical investigations were made. The CONTRACTOR shall examine the site and review the available geotechnical reports or undertake its own subsurface investigation prior to submitting its bid, taking into consideration all conditions that may affect its work.

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 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.

1.08 PROHIBITION OF BLASTING

- A. The use of explosives for excavation Work is strictly prohibited on this project.

1.09 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 of proximity of pipes, poles, conduits, walls, buildings, and all other structures, utilities, and property in the vicinity of his 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.

PART 2 -- PRODUCTS

2.01 STRUCTURAL FILL MATERIAL

- A. Materials shall be furnished as required from on-site excavations or from acceptable off-site sources as required. Structural fill material shall be clean sand or sand and rock free from vegetation, organic material, muck, or other deleterious matter, conforming to AASHTO A-1 or A-3 gradation. Not more than 10 percent by weight shall pass the No. 200

sieve. All rock shall pass through a 6-inch diameter ring. Broken Portland cement or asphaltic concrete will not be considered an acceptable fill material.

- B. Gravel Base: Washed coarse #67 aggregate for concrete with fines not more than five percent passing through the No. 200 sieve or FDOT #89 stone.

PART 3 -- EXECUTION

3.01 SITE PREPARATION

- A. Clear and grub all surface vegetation, excavating and removing all material clean to a suitable bearing soil area plus a six foot margin from the exterior foundation lines. Remove all tree stumps, concentration of roots and other deleterious materials. Stockpile usable topsoil for landscaped areas as directed by the ENGINEER.

3.02 REMOVAL OF UNSUITABLE MATERIAL

- A. Highly organic soils (peat or muck), weak silty materials, asphalt and concrete shall be removed from all foundation areas. In addition, all sandy silt zones shall be completely removed from mat foundation and footing areas. Excavations shall be carried outside slab or footing limits by one foot for each foot excavated below the bearing grade of the mat or footing.

3.03 EXCAVATION

- A. General: All excavation shall be made in such a manner, and to such widths, as will give ample room for properly constructing and inspecting the structures they are to contain. Excavation shall be made in accordance with the details shown on the Drawings, and as specified herein. Attention shall be given to the handling of storm water runoff.
- B. Excavated unsuitable material shall be removed from the site and disposed of by the CONTRACTOR.
- C. Excavated material that is suitable for use as backfill shall be used in areas where sufficient material is not available from the excavation. Suitable material in excess of backfill requirements shall be used in other areas of the site as directed by the ENGINEER or disposed of by the CONTRACTOR.
- D. The CONTRACTOR shall backfill construction areas by using clean granular materials as specified in this paragraph 3.07.
- E. Footings: Footing sides shall be formed immediately after excavation. Forming for footing sides is specified elsewhere.

3.04 UNAUTHORIZED EXCAVATION

- A. Excavation work carried outside of the Work limits required by the Contract Documents shall be at the CONTRACTOR's expense, and shall be backfilled by the CONTRACTOR at its own expense with suitable material, as directed by the ENGINEER. Where, in the

judgment of the ENGINEER, such over-excavation requires use of lean concrete or crushed stone, the CONTRACTOR, at its expense shall furnish and place such materials.

3.05 SHEETING AND BRACING

- A. Walls of the excavation shall be sloped and, if required to protect the safety of Workmen, the general public, this or other Work or structure, or excavation walls, the excavation shall be properly sheeted and braced for conditions encountered and OSHA requirements.
- B. Excavation for the structures shall be sufficient to provide a clearance between their outer surfaces and the face of the excavation, sheeting, or bracing, of not less than 2 feet. Materials encountered in the excavation which have a tendency to slough or flow into the excavation, undermine the bank, weaken the overlying strata, or are otherwise rendered unstable by the excavation operation shall be retained by sheeting, stabilization, grouting or other acceptable methods.
- C. Sheet piling may be removed (unless specifically noted to be left in place) provided its removal will not jeopardize existing or new pipes or structures. Any sheet piling left in place shall be cut-off 2 feet below finish grade, or as directed. The CONTRACTOR will not receive extra compensation for sheet piling left in place or the cut off work required.

3.06 REMOVAL OF WATER

- A. It is the basic intent of these Specifications that excavations shall be free from water before pipe or structures are installed.
- B. The CONTRACTOR shall provide pumps, well points, and other appurtenant equipment necessary to remove and maintain water at such a level as to permit construction in a dry condition except where authorized tremie concrete construction Work is shown or permitted. The groundwater level shall be controlled so as to permit the placing and curing of concrete and the maintenance of supporting foundations and adjacent Work and structures. The dewatering system and points of discharge shall meet all local regulatory requirements and be subject to review and acceptance by the ENGINEER prior to the commencement of work. The CONTRACTOR shall retain unit responsibility for meeting the requirements of all local jurisdictional agencies.
- C. The CONTRACTOR shall use dewatering systems that include automatic starting devices, and standby pumps that will ensure continuous dewatering in the event of an outage of one or more pumps. It shall be totally responsible for protecting structures from flotation until final acceptance of the Work. The CONTRACTOR shall also modify the dewatering system during the course of construction to satisfy faults, legitimate complaints or legal requirements.
- D. Disposal: Water from the trenches and excavation shall be disposed of in such a manner as will not cause injury to public health, to public or private property, to the Work completed or in progress, to the surface of the streets, cause any interference with the use of the same by the public, or cause pollution of any waterway or stream. The CONTRACTOR shall submit his proposed methods of handling trench water and locations at which the water will be disposed of to the CITY for review and shall receive acceptance before starting the excavation. Disposal to any surface water body will require silt screens to

prevent any degradation in the water body. The CONTRACTOR shall have responsibility for acquiring all necessary permits for disposal.

3.07 BACKFILLING AND COMPACTION

- A. General: Select structural fill material shall be used for all backfilling Work. Fills under mats and footing shall be placed in the dry with loose lift thicknesses of 8 inches or less. Each lift of fill and all subgrades under structures shall be compacted to achieve a minimum of 95% modified Proctor maximum dry density in accordance with ASTM D 1557. Compaction shall be accomplished by use of a minimum 15 overlapping passes of a vibratory drum roller which imparts 20 tones of dynamic force to the subgrade or fill material. The roller shall be operated at the high frequency setting at approximately 1.5 miles per hour (slow walk pace). Testing shall be as noted at the end of this Section. The CONTRACTOR shall coordinate and cooperate with the testing laboratory as described in Article 1.05.
- B. Compact area by means of small walk-behind double drum roller or equal equipment. Compaction must achieve a minimum density of 95 percent of soils modified Proctor Density as tested for the depth of 2 ft. to 3 ft. below foundation level.
 - 1. Proof roll the exposed stripped and excavated surface area by means of an approved heavy vibratory roller (Dynapac CA25 or equal) until ten (minimum) passes have been made and a soil density of 95 percent of maximum modified Proctor Density (ASTM D-1557) has been achieved twenty-four inches below the exposed compacted surface. Test compaction as specified. Add water if necessary to bring up moisture to optimum levels. Replace all material if determined to be deleterious in areas that "yield" during the final rolling operation and replace with suitable fill material.
 - 2. Heavy vibratory equipment (Dynapac CA25 or equal) should be used only in areas greater than 75 feet from existing structures. Within 75 feet of any existing structure, non-vibratory compaction equipment such as a heavy rubber-tired front-end loader with a minimum bucket capacity of three (3) cubic yards should be used. The bucket should be kept full during compaction operations to increase weight. A sufficient number of passes should be made within the construction area to compact the in-place soil to a minimum density of 95% (ASTM D-1557) as tested for the depth of two (2) feet below footing bottoms and slabs on-grade.
 - 3. If ground water is within twelve to twenty-four inches from the ground surface, it will be necessary to lower the ground water to permit effective compaction. Lowering of the ground water may be accomplished by excavating four to five feet deep ditches around the construction area and pumping from sumps in the bottom of ditches.
- C. Foundation Preparation (Filling, Backfilling and Excavation):
 - 1. Structures below water table: Level the bottom of dewatered excavation. Remove any unsuitable foundation materials and replace with gravel. Place clean gravel to thickness and extension beyond the foundation slab as indicated on plans. Compact gravel to form a stable working surface with hand held compactors. Keep water table to a minimum of 2 feet below gravel.

2. Buildings: After proof rolling of the stripped building area, place approved fill material within the building foundation lines plus a 6 foot margin in lifts of 12-inch maximum loose thickness. Compact each lift to a minimum of 95 percent Modified Proctor density 12 inches below the surface.
 3. Excavation for all building footings and treatment plant structure foundations shall be made through precompacted soils/building pad to design elevations. Bottom of excavation shall be additionally compacted to 95% of Modified Proctor Density 12-inches below the surface by portable vibratory sled type compactors. Test compaction as specified.
 4. Building Slab Backfill: Place fill inside the building foundation walls in lifts of 6-inches maximum loose thickness, each lift compacted with vibratory portable compactors and fill brought to bottom of the slab. Add necessary water to each lift to bring moisture content to optimum levels and compacting to achieve a minimum of 95% of modified Proctor Density 6-inches below the surface.
 5. Form monolithic slab beams by excavating from the compacted fill material to grades and lines indicated on the drawings.
 6. Place all backfill under the slabs, around utility trenches, mechanical and plumbing pipes, etc., in layers of six inches maximum loose thickness and compact with portable plate compactors to achieve a minimum of 95% of Modified Proctor density as per ASTM D-1557.
 7. Equipment Pads and Slabs on Grade: Cut, fill and compact subgrades for concrete slabs to required grade. Compact top 8-inches of concrete slab subgrade in cut sections and all fill material to a density of not less than 95 percent of its maximum density 12" below the surface as determined by ASTM D-1557.
 8. Test compaction of all structural fill by a testing lab as specified.
 9. Vibratory compaction shall never be done on dry sandy material or when water table is within eighteen inches of the surface. Before start of vibratory compaction, the soils should either have natural moisture or applied water to bring the soils to optimum moisture content.
- D. Final Grades: Final fill grades shall be within 0.1 foot of elevations shown. Unless otherwise shown on the Drawings, surfaces shall be sloped for drainage or other purposes.
- E. Backfill Against Structures: Backfill against concrete or masonry structure shall not be performed until the Work has been reviewed by the ENGINEER and backfilling permitted. Backfill against walls shall also be deferred until the structural slab for floors above the top fill line have been placed and attained design strength (or earlier at the discretion of the ENGINEER). Partial backfilling against adequately braced walls may be considered by the ENGINEER on an individual situation basis. Where walls are to be waterproofed all Work shall be completed and membrane materials dried or cured according to the manufacturers instructions before backfilling.

- F. Well Pointed Areas: For fills being placed in confined areas within well pointed areas, the water table shall be lowered and maintained within practical limits in order that as much dry fill material may be placed and compacted as possible.

3.08 TESTING

- A. All soil testing and earthwork monitoring will be done by a testing company in conformance with Paragraph 1.05. Notify the Testing Lab in time to be on hand to make the tests required by these specifications. The testing lab will inform the project superintendent of its findings for designating areas which will require corrective Work.
- B. Optimum moisture content of fill material will be determined by Modified Proctor Method (ASTM D-1557). Field density tests will be conducted to verify compaction in accordance with ASTM D-1556, ASTM D-2927, or ASTM D-2922.
- C. Compaction tests that fail to pass after additional compaction will continue to be reworked by the CONTRACTOR until the specified minimum compaction is achieved. Two additional tests shall be taken for each failed test. Cost of all rework and retests shall be borne by the CONTRACTOR.

D. Field Density Tests for Each Structure

Stripped Area	1 Test /1500 S.F. (2 Min)
Filled Area	1 Test/1500 S.F./Each Layer (3 Min)
Bottom of Wall Footings	1 Test/75 L.F. (3 Min)
Backfill within Foundation Walls	1 Test/750 S.F./ Each Layer
Column Footings	1 Test/Every 2 footings

E. Optimum Moisture Content

Existing Stripped Area (Proctor)	1 Test (min)/Structure
Backfill Material Proctor	1 Test/500 C.Y./Source

- END OF SECTION -

SECTION 02260 - FINISH GRADING

PART 1 -- GENERAL

1.01 WORK INCLUDED

- A. The CONTRACTOR shall, under this Section, supply, place, compact and roll finish grade materials prior to landscaping work.
- B. Finish grade sub-soil.
- C. Cut out areas to receive stabilizing base course materials for paving and sidewalks.
- D. Place, finish grade and compact topsoil.

1.02 RELATED WORK

- A. Section 02210 - Site Grading
- B. Section 02222 – Excavation and Backfill for Utilities

1.03 PROTECTION

- A. The CONTRACTOR shall prevent damage to existing structures, fencing, trees, landscaping, natural features, bench marks, pavement, utility lines, and sprinkler system. In addition the CONTRACTOR shall correct all damaged areas at no cost to the CITY.

PART 2 -- PRODUCTS

2.01 MATERIALS

- A. Topsoil shall be friable loam free from subsoil, roots, grass, excessive amount of weeds, stones and foreign matter; acidity range (pH) of 5.5 to 7.5; containing a minimum of 4% and a maximum of 25% organic matter.
- B. Crushed stone for general grading purposes shall be as specified in Section 02222.

PART 3 -- EXECUTION

3.01 SUB-SOIL PREPARATION

- A. Rough grade sub-soil systematically to allow for a maximum amount of natural settlement and compaction. Eliminate uneven areas and low spots. Remove debris, roots, branches, stones, etc., in excess of 2 inches in size.
- B. Cut out areas, to sub-grade elevation, which are to receive stabilizing base for paving and sidewalks.

- C. Bring sub-soil to required levels, profiles and contours. Make changes in grade gradual. Blend slopes in to level areas.
- D. Slope grade away from building minimum 4 inches in 10 feet (unless indicated otherwise on Drawings).

3.02 PLACING TOPSOIL

- A. Place topsoil in area where seeding, sodding and planting is to be performed. Place to the following minimum depths, up to finished grade elevations:
 - 1. 6-inches for seeded areas.
 - 2. 4 1/2-inches for sodded areas.
 - 3. 24-inches for shrub beds.
 - 4. 18-inches for flower beds.
- B. Use topsoil in relatively dry state. Place during dry weather.
- C. Fine grade topsoil eliminating rough and low areas to ensure positive drainage. Maintain levels, profiles and contours of sub-grades.
- D. Remove stones, roots, grass, weeds, debris and other foreign material while spreading.
- E. Manually spread topsoil around trees, plants, buildings and other structures to prevent damage which may be caused by grading equipment.
- F. Lightly compact placed topsoil.

3.03 SURPLUS MATERIAL

- A. Remove surplus sub-soil and topsoil from site.
- B. Leave stockpile areas and entire job site clean and raked, ready to receive landscaping.

- END OF SECTION -

SECTION 02500 - SURFACE RESTORATION

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. Items specified in this Section include repairs to landscaped and grassed areas that may be damaged or disturbed by CONTRACTOR activities.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Asphaltic Concrete Pavement.
- B. Site Grading
- C. Concrete Pavement, Curb, and Sidewalks

1.03 SUBMITTALS

- A. The CONTRACTOR shall submit submittals for review in accordance with the Section 01300 - Submittals.

1.04 DEFINITIONS

- A. The phrase "DOT Specifications" shall refer to the Florida Department of Transportation Standard Specifications for Road and Bridge Construction. The DOT Specifications are referred to herein and are hereby made a part of this Contract to the extent of such references, and shall be as binding upon the Contract as though reproduced herein in their entirety.

1.05 PROTECTION OF EXISTING IMPROVEMENTS

- A. The CONTRACTOR shall be responsible for the protection of all pavements 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 shall be repaired by the CONTRACTOR at his expense.

1.06 GUARANTEE

- A. The CONTRACTOR shall guarantee all trees, ground cover or shrubs planted or replanted under this Contract for a period of one year beyond acceptance of the project. In the event that any new tree, plant or shrub dies within the guarantee period, the CONTRACTOR shall be responsible for replacement in kind. In the event that a transplanted (reused) tree dies within the guarantee period, the CONTRACTOR shall be responsible for replacement in kind, except that the maximum height of any new tree shall be eight feet as measured from the ground surface, once planted, to the top of the tree.

PART 2 -- PRODUCTS

2.01 REPLACEMENT TREES, GROUND COVER AND SHRUBS

- A. Replacement trees, ground cover and shrubs shall be of the same type and size and sound, healthy and vigorous, well branched and densely foliated when in leaf. They shall have healthy, well developed root systems and shall be free of disease and insect pests, eggs or larvae.

2.02 MULCH

- A. Mulch shall be windproof shredded eucalyptus; mulch shall be clean, fresh, free of branches and other foreign matter. Mulch shall be used around all shrubs, ground covers and tree trunks, and placed to a minimum depth of 2 inches extending from the tree trunk outward two feet.

2.03 GRAVEL BEDS

- A. Filter Fabric: Filter fabric shall be nonwoven polyester material Trevia Type 1120 as manufactured by Hoechst Fibers Industries, or equal. Fabric weight shall be 6 ounces per square yard, puncture strength maximum 40 pounds, minimum Flux 240 gallons per minute per square foot. Fabric shall be installed in accordance with the manufacturer's recommendations, with precautions taken to avoid tearing the fabric. Fabric shall be laid in strips with a minimum overlap of one foot.
- B. Limerock: Limerock shall meet ASTM A57 standards and shall be prewashed. Maximum size shall be 3/4 inches. Limerock shall be carefully placed and spread on the fabric to a minimum depth of 6 inches. Final grades and locations shall be as designated on the Drawings.

2.04 SOD

- A. Sod shall conform to the requirements of Section 02934 – Sodding.

PART 3 -- EXECUTION

3.01 GRADING AND SODDING

- A. The CONTRACTOR shall regrade the work areas disturbed by his construction activities to the existing grade prior to commencement of construction.
- B. Sod shall be placed on all grassed areas disturbed by construction activities, unless otherwise indicated on the Drawings. Sodding shall be in accordance with Sections 575 and 981 of the DOT Specifications.
- C. Maintenance: Sufficient watering shall be done by the CONTRACTOR to maintain adequate moisture for optimum development of the sodded areas. Sodded areas shall receive no less than 1.5 inches of water per week.

- D. Repairs to Lawn Areas Disturbed by CONTRACTOR's Operations: Lawn areas damaged by CONTRACTOR's operations shall be repaired at once by proper sod bed preparation, fertilization and resodding, in accordance with these specifications. Regardless of the condition of the lawn area (weed content etc.) prior to the CONTRACTOR working in the area, all repairs shall be made with sod.

3.02 TREES, GROUND COVER AND SHRUBS

- A. Excavation and Plant Holes: Plant hole excavations shall be roughly cylindrical in shape, with the side approximately vertical. Plants shall be centered in the hole. Bottoms of the holes shall be loosened at least six inches deeper than the required depth of excavation.
- B. Holes for balled and burlaped plants shall be large enough to allow at least eight inches of backfill around the earth ball. For root balls over 18 inches in diameter, this dimension shall be increased to 12 inches. Where excess material has been excavated from the plant hole, the excavated material shall be disposed of as and where directed by the CITY.
- C. Setting of Plants: When lowered into the hole, the plant shall rest on a prepared hole bottom such that the roots are level with, or slightly above, the level of their previous growth and so oriented such as to present the best appearance. The CONTRACTOR, when setting plants in holes, shall make allowances for any anticipated settling of plants.
- D. Palms of the sabal species may be set deeper than the depth of their original growth, provided that the specified clear trunk height is attained.
- E. The backfill shall be made with planting mixture and shall be firmly rodded and watered-in, so that no air pockets remain. The quantity of water applied immediately upon planting shall be sufficient to thoroughly moisten all of the backfilled earth. Plants shall be kept in a moistened condition for the duration of the Contract.
- F. Staking and Guying: Plants shall be staked in accordance with the following provisions:
1. Small Trees: For trees and shrubs of less than one-inch caliper, the size of stakes and the method of tying shall be such as to rigidly support the staked plant against damage caused by wind action or other effects. Trees larger than one inch and smaller than one and one-half inch caliper shall be staked with a two-inch stake, set at least 24 inches in the ground and extending to the crown of the plant. The plant shall be firmly fastened to the stake with two strands of 14 gauge soft wire, enclosed in rubber hose, or other approved covering. The wire shall then be nailed or stapled to the stake to prevent slippage.
 2. Medium Trees: All trees, other than palm trees, larger than one and one-half inch caliper and smaller than two and one-half inch caliper shall be staked with two or more, two-inch by two-inch stakes, eight feet long, set two feet in the ground. The tree shall be midway between the stakes and held firmly in place by two strands of 12-gauge wire, applied as specified above for single stakes. The wires shall be tightened and kept tight by twisting.

3. Large Trees: All trees, other than palm trees, larger than two and one-half inch caliper, shall be braced with three or more two-inch by four-inch wood braces, toenailed to cleats which are securely banded at two points to the palm, at a point at least six feet above the ground. The trunk shall be padded with five layers of burlap under the cleats. Braces shall be approximately equidistantly spaced and secured underground with two-inch by four-inch by 24-inch stake pads. In firm rock soils, Number 4 steel reinforcing rods or one-half inch pipe is acceptable.
 4. Palm Trees: Palm trees shall be braced with three or more two-inch by four-inch wood braces, toenailed to cleats which are securely banded at two points to the palm, at a point at least six feet above the ground. The trunk shall be padded with five layers of burlap under the cleats. Braces shall be approximately equidistantly spaced and secured underground with two-inch by four-inch by 24-inch stake pads. In firm rock soils, Number 4 steel reinforcing rods or one-half inch pipe is acceptable.
- G. Pruning: All broken or damaged roots shall be cut off smoothly, and the tops of all trees shall be pruned in a manner complying with standard horticultural practice. At the time pruning is completed, all remaining wood shall be alive. All cut surfaces of one inch or more in diameter, above the ground, shall be treated with an approved commercial tree paint.
 - H. Maintenance: Maintenance shall begin immediately after each plant is planted and shall continue until all work under this Contract has been completed and accepted by the CITY. Plants shall be watered, mulched, weeded, pruned, sprayed, fertilized, cultivated and otherwise maintained and protected. Settled plants shall be reset to proper grade position, planting saucer restored and dead material removed. Guys shall be tightened and repaired.
 - I. Defective work shall be corrected as soon as possible after it becomes apparent. Upon completion of planting, the CONTRACTOR shall remove excess soil and debris, and repair any damage to structures, etc., resulting from planting operations.
- 3.03 GRAVEL BEDS
- A. Clean, grade and place geotextile prior to placing gravel in gravel beds.

- END OF SECTION -

SECTION 02510 - ASPHALTIC CONCRETE PAVEMENT

PART 1 - GENERAL

1.01 THE REQUIREMENT

- A. Construct asphaltic concrete pavement in accordance with the lines, grades and typical sections as indicated on the Drawings, specified herein and as required for a complete installation.
- B. Replace and / or repair all existing asphaltic concrete pavement areas impacted by contractor operations, including trenching for new utilities, as well as damage that may result from contractor operations during the progress of the Work.
- C. Temporary asphalt / trench repairs shall be installed within 1 week of excavation and backfill work on plant roadways impacted by construction.

1.02 SUBMITTALS

- A. The CONTRACTOR shall submit its proposed formulae for the asphaltic concrete paving for review in accordance with the Section entitled "Submittals".

1.03 QUALITY CONTROL

- A. The phrase "DOT Specifications" shall refer to the Florida Department of Transportation Standard Specifications for Road and Bridge Construction. The DOT Specifications, are referred to herein and are hereby made a part of this Contract to the extent of such references, and shall be as binding upon the Contract as though reproduced herein in their entirety.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Limerock Base: The limerock base shall consist of two courses of Miami Oolite limerock in accordance with Sections 200 and 911 of the DOT Specifications.
- B. Prime Coat: The material used for the prime coat shall be cut-back Asphalt Grade RC-70 conforming to Sections 300 and 916 of the DOT Specifications for prime to be used on Miami Oolite formation limerock.
- C. Asphaltic Concrete: Type SP 9.5 and SP 12.5 meeting the requirements in Section 334 of the DOT Specifications.
- D. Reclaimed Asphalt: Reclaimed asphalt shall not be utilized.

- E. Tack Coat: The material used for the tack coat shall be emulsified asphalt grade RS-2 conforming to DOT Sections 300 and 916.

PART 3 -- EXECUTION

3.01 INSTALLATION

- A. Subgrade: Roadway subgrades shall be stabilized to the minimum depth shown on the Drawings to a Florida Bearing Value (F.B.V.) of not less than 75. Stabilizing shall be type C as defined in Section 160 of the DOT specifications. Stabilization may require the addition and thorough mixing in of crushed limerock, coarse limerock screenings, or any other stabilizing material acceptable to the ENGINEER. The stabilizing material shall be applied in such quantity that, after mixing and blending, the subgrade will have a F.B.V. of not less than 75. Stabilizing material shall be mixed or blended in the subgrade material by plowing, scarifying, disking, harrowing, blading and mixing with rotary tillers until the mixed materials are of uniform bearing value throughout the width and depth of the layer being processed. The minimum acceptable density at any location will be 100 % of maximum dry density as determined by AASHTO T-180.
- B. At least three density determinations shall be made on each day's final compaction operations on each course and the density determinations shall be made at more frequent intervals if deemed necessary by the ENGINEER.
- C. Limerock Base: The limerock base shall be constructed in accordance with Section 200 of the DOT Specifications, to the thickness and width indicated on the Drawings. Pavement base shall be constructed in two lifts.
- D. After spreading of the base material is completed, the entire surface shall be scarified and shaped so as to produce the exact grade and cross section after compaction. For double course base, this scarifying shall extend a depth sufficient to penetrate slightly the surface of the first course. The maximum depth of each lift shall be 6-inches.
- E. When the material does not have the proper moisture content to insure the required density, wetting or drying shall be required. If the material is deficient in moisture, water will be added and uniformly mixed in by disking the base course to its full depth. If the material contains an excess of moisture, it shall be allowed to dry before being compacted. Wetting and drying operations shall involve manipulation of the entire width and depth of the base as a unit. As soon as proper conditions of moisture are attained, the material shall be compacted to an average density not less than 98% of maximum dry density as determined by AASHTO T-180. Where the base is being constructed in more than one course, the density shall be obtained in each lift of the base.
- F. During final compacting operations, if blading of any areas is necessary to obtain the true grade and cross section, the compacting operations for such areas shall be completed prior to making the density determination on the finished base.

- G. Unless otherwise directed by the ENGINEER, the surface shall be "hard-planed" with a blade grader immediately prior to the application of the prime coat to remove the thin glaze or cemented surface and to allow free penetration of the prime material. The materials planed from the base shall be removed from the base area.
- H. If cracks or checks appear in the base, either before or after priming, which in the opinion of the ENGINEER, would impair the structural efficiency of the base course, the CONTRACTOR shall remove such cracks or checks by reclarifying, reshaping, adding base material where necessary and recompact, at no additional cost to the Owner.
- I. Mixing Base and Subgrade: If at any time the subgrade material shall become mixed with the base course material, the CONTRACTOR shall, without additional compensation, dig out and remove the mixture, reshape and compact the subgrade and replace the materials removed with clean base material, which shall be shaped and compacted as specified above.
- J. Prime Coat: The prime coat shall be applied at a rate of 0.15 gallons per square yard and the work performed in accordance with Section 300 of the DOT Specifications.
- K. Asphaltic Concrete: The spreading, compacting and jointing the wearing surface shall be in accordance with Sections 330 and 333 of the DOT Specifications to the thickness indicated on the Drawings.
- L. Tack Coat: Apply tack coat at a rate between 0.02 and 0.10 gallons per square yard, and perform the Work in accordance with Section 300 of the DOT Specifications.

3.02 TEMPORARY TRENCH REPAIR OR STABILIZATION

- A. Following trenching and backfill within active plant roadways, but prior to final asphalt replacement at substantial completion, the CONTRACTOR shall install temporary trench repair, consisting of compacted base course and temporary asphalt.
- B. Temporary trench repair shall include the preparation of the subgrade, the placing and compacting of the limerock base, the priming of the base, the placing and maintaining of the surface treatment, all as specified herein.
- C. The width of trench repairs shall extend at least 12 inches beyond the limits of the asphalt impacted by excavation. The edge of the pavement to be left in place shall be cut to a true edge with a saw or other approved method so as to provide a clean edge to abut the repair. The line of the repair shall be reasonably uniform with no unnecessary irregularities.

3.03 PAVEMENT MARKINGS

- A. All existing markings (i.e., lanes, edge of pavement, parking stalls, etc.) impacted by the CONTRACTOR during construction shall be replaced with new painted items in accordance with the requirements of Section 971 of the DOT Specifications.

3.04 CONNECTIONS WITH EXISTING FACILITIES

- A. Where the bituminous pavement is to be connected with an existing roadway surface or other facility, the CONTRACTOR shall modify the existing roadway profile in such a manner as to produce a smooth riding connection to the existing facility.
- B. Where it is necessary to remove existing asphalt surfaces to provide proper meet lines and riding surfaces, the CONTRACTOR shall saw cut 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.

3.05 SURFACE TOLERANCE

- A. Tests for conformity with the specified grade shall be made 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 Section 330-12.4 of the DOT 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

3.06 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 ENGINEER 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.

3.07 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 covers of these improvements to conform with the proposed surface elevations.
- C. In this effort, the CONTRACTOR shall be responsible for ensuring 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.

3.08 PAVEMENT WARRANTY

- A. Settlement of replaced pavement over trenches within the warranty period shall be considered the result of improper or inadequate compaction of the sub-base or base materials. The CONTRACTOR shall promptly repair all pavement deficiencies noted during the warranty period at the CONTRACTOR's sole expense.

- END OF SECTION -

SECTION 02526 – CONCRETE PAVEMENT, CURBS AND SIDEWALKS

PART 1 -- GENERAL

1.01 SCOPE

- A. The CONTRACTOR shall construct concrete pavement, curbs and sidewalks to the lines and grades and dimensions required for a complete installation as shown on the Drawings and specified herein.
- B. Damaged concrete pavement, curbs and sidewalks, and other improvements shall be reconstructed as new to existing lines and grades and dimensions. Where pavement, curbs, and sidewalks are partially damaged on private property, the CONTRACTOR shall fully reconstruct the structure in-kind to provide an entirely new structure.

1.02 SUBMITTALS

- A. Shop drawings for reinforcing, joint material and mix designs shall be submitted for review in accordance with the Section entitled "Submittals".

PART 2 -- PRODUCTS

2.01 CONCRETE

- A. Concrete shall be Class B as specified in Division 3, unless noted or specified otherwise.

2.02 REINFORCING AND WELDED WIRE FABRIC

- A. Joint reinforcing and welded wire fabric shall conform to the requirements of Division 3.

2.03 PREFORMED JOINT FILLER

- A. Preformed joint filler shall be sponge rubber or cork and conform to the requirements of AASHTO Designated M153, Type I or II.

2.04 CURING COMPOUND

- A. Curing Compound shall conform to the requirements of AASHTO M148, Type I.

PART 3 -- EXECUTION

3.01 SUBGRADE CONDITION

- A. The finished subgrade shall be maintained in a smooth, compact condition and any areas which are disturbed prior to placing of the concrete shall be restored at no additional cost to the CITY.

- B. The subgrade shall be moist at the time the concrete is placed. Water shall be uniformly applied ahead of the paving operations as directed by the CITY. If the CONTRACTOR does not maintain the subgrade in the required moist condition, a polyethylene sheet vapor barrier will be required between the subgrade and the concrete.
- C. The subgrade shall be accurately trimmed to the required elevation with a 1/4 inch tolerance. High areas shall be trimmed to proper elevation. Low areas may be filled with suitable material and compacted to the specified density or filled with concrete integrally with the placing of the pavement.
- D. Boulders, rocks or obstructions larger than 1-inch diameter shall be removed to a minimum depth of 6-inches below finished subgrade. The subgrade shall be compacted at optimum moisture content to 98 percent of maximum dry density in accordance with ASTM D1557 method D.

3.02 SETTING FORMS

- A. The forms shall be accurately set to line and grade and such that they rest firmly, throughout their entire length upon the compacted subgrade surface. Forms shall be joined neatly and tightly and braced to test the pressure of the concrete and the finishing operations. The alignment and grade of all forms shall be approved before and immediately prior to the placing of concrete.

3.03 MIXING CONCRETE

- A. Concrete shall be mixed in accordance with Division 3.

3.04 PLACING CONCRETE

- A. The concrete shall be distributed on the subgrade to such depth, that, when it is consolidated and finished, the slab thickness required by the Drawings will be obtained at all points and the surface will at no point be below the grade specified for the finished surface, after application of the allowable tolerance. The concrete shall be deposited on the subgrade in a manner which will require as little rehandling as possible.
- B. Fabric reinforcement shall be placed at mid slab depth, and the fabric shall be maintained at this location during the placing and finishing operations.
- C. Concrete shall be thoroughly consolidated against and along the faces of all forms, by means of hand-operated, spud-type vibrators. Vibration at any one location shall not continue so long as to produce puddling or the accumulation of excessive grout on the surface. In no case shall the vibrator be operated longer than 15 seconds in any one location.

3.05 STRIKING-OFF, CONSOLIDATING AND FINISHING CONCRETE

- A. Immediately after the placing, the concrete shall be struck off, consolidated and finished, to produce a finished pavement conforming to the cross section, width and surface sequence of operations shall be as follows: strike-off; vibratory consolidation; screening; floating; removal of laitance; straightedging; and final surface finish.

3.06 STRAIGHTEDGING AND SURFACE CORRECTIONS

- A. After floating has been completed and the excess water removed, but while the concrete is still in a plastic state, the surface of the concrete shall be tested for trueness with an accurate 10 foot straightedge. The straightedge shall be furnished by the CONTRACTOR. The straightedge shall be held in successive positions parallel to the road center line, in contact with the surface, and the whole area tested from one side of the slab to the other as necessary. Any depressions shall be immediately filled with freshly mixed concrete and struck-off; consolidated and refinished. High areas shall be cut down and refinished. Straightedge testing and surface correction shall continue until the entire surface appears to conform to the required grade and cross section.

3.07 FINAL FINISH

- A. As soon as the water sheen has disappeared from the surface of the pavement and just before the concrete becomes nonplastic, a light broom finish shall be given to the surface.

3.08 EDGING

- A. After the final finish has been applied, but before the concrete has become nonplastic, the edges of the pavement along each side of the strip being placed, on each side of construction joints and along any structure extending into the pavement, shall be carefully rounded to a 1/4 inch radius except as otherwise indicated. A well-defined and continuous radius shall be produced and a smoother, dense mortar finish obtained. All concrete shall be completely removed from the top of the joint filler.
- B. All joints shall be checked with a straightedge before the concrete has become nonplastic and, if one side of the joint is higher than the other or the entire joint is higher or lower than the adjacent slabs, corrections shall be made as necessary.

3.09 JOINTS

- A. Construction Joints: Construction joints shall be located as shown on the Drawings.
- B. Expansion Joints Around Structures: Expansion joints shall be formed by placing premolded expansion joint material about all structures and features projecting through, into or against the pavement. Unless otherwise indicated, such joints shall be 1/2 inch in width. Expansion joints shall be sealed with a joint sealer. Sealant application procedures shall be as recommended by the manufacturer.
- C. Transverse Expansion Joints: Open type transverse expansion joints shall be provided at all sidewalk returns and at 50 feet intervals and wherever indicated on the Drawings. Open type joints shall be formed by staking a 1/4 inch thick metal bulkhead in place and placing concrete on both sides. After the concrete has set sufficiently to preserve the width and shape of the joint, the bulkhead shall be removed. After the sidewalk has been finished over the joint, the slot shall be opened and edged with a tool having a 1/2 inch radius. Transverse expansion joints shall be cleaned and filled with joint filler strips 1/4 inch thick conforming to the requirements of AASHTO M-153 and sealed with a joint sealer. Sealant application procedures shall be as recommended by the manufacturer.

- D. Scored Joints: Scored joints shall be either formed or sawed at 5-foot intervals and shall extend to a depth of at least one fourth of the sidewalk slab thickness.

3.10 CURING

- A. After the finishing operations have been completed and as soon as the concrete has hardened sufficiently that marring of the surface will not occur, the entire surface and the edges of the newly placed concrete shall be covered and cured with membrane curing compound.
- B. Curing compound shall be uniformly applied to the surfaces to be cured, in a single coat, continuous film, at the rate of one gallon to not more than 200 square feet, by a mechanical sprayer.
- C. Curing compound shall not be applied during periods of rainfall. Curing compound shall not be applied to the inside faces of joints to be sealed. Should the film become damaged from any cause within the required curing period, the damaged portions shall be repaired immediately with additional compound. Upon removal of side forms the sides of the slabs exposed shall immediately be coated to provide a curing treatment equal to that provided for the surface.

3.11 CURB AND SIDEWALK CONSTRUCTION

- A. The concrete curbs and sidewalks shall be constructed on a prepared smooth subgrade of uniform density. Large boulders and other obstructions shall be removed to a minimum depth of 6 inches below the finished subgrade elevation and the space shall be backfilled with sand, base course material or other suitable material which shall be thoroughly compacted by rolling or tamping. The CONTRACTOR shall furnish a template and shall thoroughly check the subgrade prior to depositing concrete.
- B. Concrete for curbs and sidewalks shall be formed, mixed, placed and finished in conformance with the requirements of Sections of Division 3, except as modified herein. Concrete shall be cured with a clear membrane curing compound which shall be applied at a uniform rate of one gallon per 200 square feet in accordance with the requirements specified herein before, under Pavement Construction. Sidewalks shall be given a light broom finish.

3.12 CURBS

- A. Curbs shall be constructed in uniform sections ten feet in length except where shorter sections are necessary for closures or arcs. The sections shall be separated by sheet metal templates set perpendicular to the face and tip of the curve and not less than 2 inches longer than the depth of the curb. The templates shall be held firmly during the placing of the concrete and shall be allowed to remain in place until the concrete has set sufficiently to hold its shape, but shall be removed while the forms are still in place.
- B. After the concrete has sufficiently set for a minimum of 12 hours, the CONTRACTOR shall remove the forms and backfill the spaces on each side. The earth shall be compacted in satisfactory manner with out damage to the concrete work. Minor defects

shall be filled with a mortar composed of one part portland cement and two parts fine aggregate.

3.13 PAVEMENT CURB AND SIDEWALK REPAIR

- A. All damage to pavement, curb or sidewalk 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 CITY. The repair shall include all work as specified herein.
- B. The width of all repairs shall extend at least 12 inches beyond the limit of the damage. The edge of the pavement curb or sidewalk to be left in place shall be cut to a true edge with a saw or other approved method so as to provide a clean edge to abut the repair. The line of the repair shall be reasonably uniform with no unnecessary irregularities.

- END OF SECTION -

SECTION 02667 - WATER TIGHTNESS TESTING

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The CONTRACTOR shall perform all cleaning, flushing, and testing, of all structures identified below, including conveyance of test water from CITY-designated source to point of use, and including all disposal thereof, complete and acceptable, all in accordance with the requirements of the Contract Documents. Water tightness testing shall be performed on the following structures:
 - 1. Effluent Trough of Clarifier No. 2 between bulkheads
- B. It is the intent of these Specifications that all concrete work, concrete repair work, sealing around built-in items and penetrations be performed as required to ensure that groundwater, surface water, and water or liquids in tanks, containment areas, channels, and containers will not intrude into any equipment rooms, pipe trenches, habitable areas or other generally dry areas.
- C. The required water tightness shall be achieved by quality concrete construction and proper sealing of all joints and penetrations.

1.02 SUBMITTALS

- A. Test reports: Test reports shall include the results of the water tightness testing as follows: Test locations in the structure, dates of testing, water level measurements, amounts of precipitation or evaporation (when applicable), measured temperatures and volume corrections (if any), retest results, corrective actions taken, and final results. Final reports shall be provided within 7 days of test completion.

PART 2 -- PRODUCTS

2.01 MATERIALS REQUIREMENTS

- A. Temporary valves, bulkheads, or other water control equipment and materials necessary to perform all required tests shall be provided by the General Contractor at his own expense and subject to the Engineer's review. No materials shall be used which would be injurious to the construction or its future function.

PART 3 -- EXECUTION

3.01 GENERAL

- A. Water for testing will be furnished by the CITY; however, the CONTRACTOR shall make all necessary provisions for conveying the water from the CITY-designated source to the points of use.

- B. Release and disposal of water from structures, after testing has been completed, shall be acceptable to the ENGINEER.

3.02 TESTING OF STRUCTURES

- A. The structure should have the entire exterior surface (including areas that are to be backfilled) visible during the test. Testing shall be performed prior to backfilling, and coating of interior and exterior surfaces of walls. Waterproofing in accordance with Specification Section 03732 shall be applied prior to the test.
- C. Testing shall not be performed sooner than 14 days after all portions of structure walls and associated roof systems have been completed nor sooner than when the tank's concrete has attained its specified compressive strength.
- D. Test preparation shall be in accordance with the requirements of section entitled "Hydrostatic Tightness Test for Open or Covered Containment Structures" of ACI 350.1-10.
- E. The test shall consist of two parts in conformance with the requirements of ACI 350.1-10.
 - 1. Part 1 shall be a visual test. Failure criteria for Part 1 of the test shall be in accordance with the requirements of section entitled "Hydrostatic Tightness Test for Open or Covered Containment Structures" of ACI 350.1-10.
 - 2. After the structure has been filled and visible leaks repaired, Part 2 of the test shall be performed. Part 2 shall be a quantitative test in accordance with the requirements of section entitled "Hydrostatic Tightness Test for Open or Covered Containment Structures" of ACI 350.1-10. Water loss shall not be greater than 0.025% of volume per day.
- F. Water level for the test shall be the maximum capacity of the structure. All visible leakage shall be repaired in accordance with repair methods submitted herein and as specified in applicable sections of Divisions 3 and 15 of these Specifications, and as approved by the Engineer.
- G. Method of calculating allowances for precipitation and evaporation shall be agreed upon by both ENGINEER and CONTRACTOR prior to testing.
- H. If intermediate readings, observed leakage, unusual precipitation or other external factors indicate that the allowable leakage will be exceeded, the test may be terminated before the end of the test period and appropriate action taken to correct the problem before commencing a new test period. Should the structure fail to pass the test, the test may be repeated once.
- I. It shall be permitted to immediately retest if Part 2 of the test fails when part 1 has passed. If the structure fails the second test, the CONTRACTOR shall empty the structure as acceptable to the ENGINEER and shall examine the interior for evidence of any cracking or other conditions that might be responsible for the leakage. Any evidence of leakage shall be repaired. Following these operations, the CONTRACTOR shall again test the structure. The structure will not be accepted as completed until the water loss leakage test is passed and all visible leakage repaired.

- J. The structures that fail the test shall be repeatedly retested until it passes the leakage test criteria specified herein. The CITY will not compensate the CONTRACTOR for the required additional tests.

- END OF SECTION -

SECTION 02772 – CURED-IN-PLACE PIPE RECONSTRUCTION OF PRESSURIZED PIPING

PART 1 – GENERAL

1.01 INTENT

- A. It is the intent of this specification to provide for the reconstruction of the designated pressure pipe by inversion and curing a new cured-in-place-pipe (CIPP) within the existing (host) pipe. CIPP is to encompass the wall piece and the approximate external limits shown on the Drawings. All pipe inside the pump station is to be replaced. Due to the possibly unstable condition of the host pipe, the new CIPP shall be designed as a fully structural pipe, not relying on the remaining strength of the host pipe to withstand long-term external loading and internal pressure.

1.02 REFERENCED DOCUMENTS

- A. This specification references ASTM F1216 which is made a part hereof by such reference and shall be the latest edition and revision thereof. In case of conflicting requirements between this specification and F1216, this specification will govern.

1.03 SUBMITTALS

- A. The materials and work specified herein shall be furnished and performed by firms who are fully experienced, reputable, and qualified. The materials specified shall be constructed and installed in accordance with the best practice and methods. Supervisory personnel should be able to conclusively demonstrate thorough familiarity and training in the engineering, procedures, means and methods for force main lining.
- B. With the bid, the following submittals are required. Documentation for product and installation experience must be satisfactory to the OWNER and ENGINEER.
 - 1. Proposed cured-in-place liner product information, including installation references of ten force main lining projects within the last five years that are similar in size and scope to this project. The submittal shall include, at a minimum, the client contact name, phone number, the diameter and footage of pipe rehabilitated, and the date of project completion.
 - 2. An experienced supervisor shall provide a list of ten projects done within the last five years, comparable in size and scope to the work herein proposed, that he has personally supervised. The submittal shall include, at a minimum, the client contact name, phone number, the diameter and footage of pipe rehabilitated, and the date of project completion.
- C. Prior to starting work on each Work Order assignment, the following submittals are required.
 - 1. Design – Detailed design calculations for both the internal and external loading parameters specified in Section 2.02 shall be submitted for review and approval. The design submittal shall follow the requirements specified in Section 2.02. The design submittal shall also clearly identify the physical properties used for design.

2. Chemical Resistance – The CONTRACTOR shall submit test results which indicate that the CIPP system proposed meets the chemical resistance requirements of Section 3.08 B.
3. CIPP Field Samples – The CONTRACTOR shall submit physical property test results from previous installations of the product proposed for this project. These test results shall verify that the CIPP physical properties used in the design submittal (Section 1.03 C.1) have been achieved in previous applications.
4. Access Points – The CONTRACTOR shall submit the number, location, and general description of access points required for installation.
5. End Seals – CONTRACTOR shall submit details of proposed materials, installation procedures, and testing procedures for approval prior to performance of the work.
6. Reinstatements – The CONTRACTOR shall submit details of how existing tees, wyes, air relief valves, blow-off valves, threaded taps, etc., will be reinstated and tested. Reinstatements shall provide a sufficient seal to prevent water tracking between the pipe lining and the host pipe.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. The tube shall be fabricated with non-woven synthetic fiber combined with glass fiber reinforcement. The tube shall be fabricated to dimensions such that it will stretch to a size that when installed will cure while in contact with the existing pipe.
- B. The outside layer of the tube shall be plastic coated with a translucent flexible material that clearly allows inspection of the resin impregnation (wet out) procedure.
- C. The tube shall have a uniform thickness that when compressed at installation pressures will exceed the minimum required thickness specified in the design submittals (see Section 1.03 C.1).
- D. The tube shall be homogeneous across the entire wall thickness containing no intermediate or encapsulated elastomeric layers. The tube shall contain glass fiber reinforcement quantities appropriate for the internal pressure requirements.
- E. The pipe lining shall at a minimum achieve the full flow capacity of the original pipe before rehabilitation. Calculated capacities may be derived using a commonly accepted roughness coefficient for the existing pipe material taking into consideration its age and condition.
- F. The wall color of the interior pipe surface of the CIPP after installation shall be a light reflective color so that a clear detail examination may be made of the final product with closed circuit television inspection equipment or by man-entry.
- G. A vinyl ester or epoxy resin system that is compatible with the inversion process shall be used. When cured the composite shall meet or exceed the design physical properties used in the design submittal of the proposed product (see Section 1.03 C.1).

2.02 STRUCTURAL REQUIREMENTS

- A. The CIPP shall be designed as per ASTM F1216, Appendix X1.3.2 for the Fully Deteriorated Pressure Pipe condition.
- B. The CIPP design shall assume no bonding to the original pipe wall.
- C. The design of the CIPP shall be based on the following parameters:

Diameter	16 inch
Normal Internal Operating Pressure	30, psi
Maximum Internal Pressure	150, psi
Normal Internal Operating Temperature	78, °F
Maximum Internal Temperature	80, °F
Internal Vacuum, if applicable	N/A, psi
Soil Depth (above crown)	Refer to Drawings
Ground Water Depth (above invert)	Refer to Drawings
Type of Live Load	H-20
Modulus of Soil Reaction	700, psi
Soil Density	110, lb/ft ³

- D. The physical properties used in the design submittal (see Section 1.03 C.1) shall be clearly identified. These physical properties shall be the basis for the acceptance of prequalification submittals of previous field samples (see Section 1.03 C.3) and the acceptance of the final product (see Section 3.07.E). At a minimum, the CIPP shall have the following physical properties:

Property	ASTM Test Method	Minimum Value*
Initial Flexural Modulus of Elasticity	D790	250,000 psi
Initial Flexural Strength	D790	5,000 psi
Initial Tensile Strength	D638	4,500 psi

**Values are for design conditions @ 75°F (25°C)*

- E. For the external load design in Appendix X.1 of ASTM F1216, the long-term (time-corrected) flexural modulus of elasticity shall be determined by multiplying the design initial flexural modulus of elasticity by a creep retention factor (C_L). A creep retention factor of 50% shall be applied.
- F. The external load design shall be based on an enhancement factor (K) of 10.0, an ovality (q) of 0%, a Poisson's (ν) ratio of 0.3 and a factor of safety of 2.0.

- G. For the internal pressure design in Appendix X.1 of ASTM F1216, the design shall be based on factor of safety of 2.0 and a long-term tensile strength equal to 1/3 of the design initial tensile strength.
- H. The design physical properties shall be adjusted, as necessary, to account for the Normal Internal Operating Temperature specified in Section 2.02.C.

2.03 LINER END SEALS

- A. Existing pipe not rehabilitated shall be connected at each location where new liner begins and ends using standard pipe fittings. To prevent fluid from migrating between the inside surface of the existing rehabilitated host pipe and the external surface of the pipe liner, CONTRACTOR shall install end seals at the pipe lining beginning and termination points.
- B. The end seals shall be a mechanical expansion type, constructed of stainless steel and elastomeric seals. The end seals shall be rated by the manufacturer for the operating pressure and shall be compatible with the piped fluid. The pipe at the end seal installation point shall be structurally sound and free of any significant pitting or heavy corrosion to ensure an adequate seal between the CIPP and the existing pipeline.

PART 3 – EXECUTION

3.01 ACCESS, CLEANING AND INSPECTION

- A. Prior to entering access pits and performing inspection or cleaning operations, the CONTRACTOR shall make an evaluation of the atmosphere to determine the presence of toxic or flammable vapors or lack of oxygen in accordance with local, state, or federal safety regulations.
- B. The Contractor shall remove from the pipeline all internal debris that would interfere with the installation. Pipes shall be cleaned by the Contractor, as needed, with high-velocity jet cleaners, mechanically powered equipment, cable-attached devices or fluid-propelled devices.
- C. Inspection of pipelines shall be performed by experienced personnel trained in locating breaks, obstacles, and other important features and conditions by closed-circuit television or man entry. The interior of the pipeline shall be carefully inspected to determine the location of any conditions that may prevent proper installation of the resin-impregnated tube, and such conditions shall be documented so that appropriate corrective action can be performed. A video tape and suitable log shall be kept for reference. Corrective action, where warranted, will require the OWNER's advance authorization.
- D. The existing conduit shall be dewatered and maintained free of incoming water for the liner installation process.

3.02 RESIN IMPREGNATION

- A. The tube shall be vacuum-impregnated (wet out) with resin under controlled conditions. The quantity of resin used for tube impregnation shall be sufficient to fill the volume of air voids

in the tube with additional allowances for polymerization shrinkage and loss of resin through cracks and irregularities in the original pipe wall.

- B. The CONTRACTOR shall designate a location where the tube will be vacuum impregnated prior to installation. To ensure a thorough wet out, the point of vacuum shall be no further than 25 feet from the point of initial resin introduction. After vacuum in the tube is established, the vacuum points shall be no further than 75 feet from the leading edge of the resin. The leading edge of the resin slug shall be as near to perpendicular as possible. Vacuum points shall be sealed as they are vacated. A roller system shall be used to uniformly distribute the resin throughout the tube. The CONTRACTOR shall allow the OWNER to inspect the materials and procedures used to vacuum-impregnate the tube.

3.03 INSTALLATION

- A. The wet out tube shall be inserted through an approved access point by means of an inversion process and the application of a hydrostatic head sufficient to extend it to the termination point.
- B. Before the installation begins, the CONTRACTOR shall determine the minimum pressure required to hold the tube tight against the existing pipeline, and the maximum allowable pressure so as not to damage the tube. Once the installation has started, the pressure shall be maintained between the minimum and maximum pressures until the installation has been completed. Tube installation forces or pressures shall be limited so as not to stretch the tube longitudinally by more than 5% of the original length.
- C. The use of a lubricant during inversion may be needed to reduce friction. The lubricant used shall be a nontoxic product that has no detrimental effects on the tube or boiler and pump system, shall not support the growth of bacteria, and shall not adversely affect the fluid to be transported.

3.04 CURING

- A. After installation is completed, a suitable heat source and water recirculation equipment shall be used to circulate heated water throughout the pipeline. The equipment shall be capable of delivering hot water throughout the pipeline to uniformly raise the water temperature above the temperature required to effect a cure of the resin. Water temperature in the line during the cure period shall be as determined by the CONTRACTOR, in accordance with Manufacturer's recommendations.
- B. The heat source shall be fitted with suitable monitors to gauge the temperature of the incoming and outgoing water supply. To determine the temperatures during the cure cycle, a gauge shall be placed at the beginning and termination points between the impregnated tube and the invert of the existing pipe. The temperature of the cure water shall be monitored at the termination end by placing a temperature probe through a small hole in the tube, near the invert, into the cure water. The hole in the tube shall be made such that the temperature probe fits tightly and minimizes cure water leakage.
- C. Initial cure will occur during temperature heat-up and is completed when exposed portions of the new pipe appear to be hard and sound and the remote temperature sensor indicates that the temperature is of a magnitude to realize an exotherm or cure in the resin. After initial cure is reached, the temperature shall be raised to the post-cure temperature as

determined by the CONTRACTOR. The post-cure temperature shall be held for a period as determined by the CONTRACTOR, during which time the recirculation of the water and cycling of the boiler to maintain the temperature continues. The curing process shall take into account the existing pipe material, the resin system, and ground conditions (temperature, moisture level, and thermal conductivity of soil).

3.05 COOL-DOWN

- A. The CIPP shall be cooled to a temperature below 90 F (32 C) before relieving the hydrostatic head. Cool-down shall be accomplished by the introduction of cool water to replace water being drained from the system. Care shall be taken in the release of the static head so that a vacuum will not be developed that could damage the newly installed CIPP. In addition, the cure water internal temperature during cool-down shall not decrease at a rate greater than 20 F (11°C) per hour.

3.06 INTERNAL END SEALS AND REINSTATEMENTS

- A. The CONTRACTOR shall install end seals at the pipe liner beginning and termination points in accordance with the approved submittal under Section 1.03 C.5.
- B. The CONTRACTOR shall complete all reinstatements of tees, wyes, air relief valves, blow-off valves, threaded taps, etc. in accordance with the approved submittal under Section 1.03 C.6.

3.07 INSPECTION AND TESTING

- A. The installation shall be inspected by closed-circuit television.
- B. The finished CIPP shall be continuous over the entire length of an installation run and be free of dry spots, lifts, and delaminations.
- C. For each inversion length designated by the OWNER, one or more samples shall be prepared using one of the following methods.
 - 1. The sample shall be cut from a section of the cured pipe lining at an intermediate manhole or at the termination point that has been inverted through a like diameter pipe which has been held in place by a suitable heat sink, such as sandbags.
 - 2. The sample shall be fabricated from material taken from the tube and the resin/hardener system used and cured in a clamped mold placed in the cure water.
- D. The CIPP samples shall be large enough to provide a minimum of three specimens and a recommended five specimens for flexural testing and tensile testing.
- E. The CIPP samples shall be tested in accordance with ASTM D790 and D638 to confirm that the required physical properties specified in the design submittal of the proposed product (see Section 1.03 C.1) have been achieved.
- F. The CIPP shall meet the chemical resistance requirements of Section 3.08.

- G. The CIPP shall be pressure tested for water-tightness following the test protocol described in Section 3.09.
- H. A CCTV video inspection and recording shall be conducted as soon as possible after installation.

3.08. CHEMICAL RESISTANCE

- A. The CIPP system proposed shall meet the minimum chemical resistance requirements listed below and as previously submitted (see Section 1.03 C.2). Samples used for testing shall be of the same resin system and similar tube materials as that proposed for the project. It is required that CIPP samples without plastic coating meet these chemical testing requirements.
- B. Chemical resistance tests shall be completed in accordance with ASTM Test Method D 543 with the chemical solutions shown in the below table. Exposure shall be for a minimum of one month at 73.4°F (23°C). During this period, the CIPP test specimens shall lose no more than 20% of their initial flexural strength and initial flexural modulus of elasticity.

Minimum Chemical Resistance Requirements	
Chemical Solution	Concentration, %
Tap water (pH 6-9)	100
Nitric acid	5
Phosphoric acid	10
Sulfuric acid	10
Gasoline	100
Vegetable oil	100
Detergent	0.1
Soap	0.1

3.09 TESTING

- A. This section provides procedures for pressure testing for water-tightness of CIPP used in the renovation of pressure pipelines. Pressure testing for water-tightness and a CCTV inspection shall be conducted for the CIPP liner after installation.
- B. Pressure Testing
 - 1. The pipe lining shall be cooled down to the original ambient ground temperature, which existed before installation, prior to proceeding with the pressure test.
 - 2. The test section shall be subjected to a hydrostatic pressure of 1-1/2 times the known operating pressure (Section 2.02 C), or at the operating pressure plus 50 psi, whichever is less.

3. The pressure test shall be conducted after placement of all appurtenances such as end seals and all reinstatements such as side connections and corporation stops. To avoid the testing of other associated piping, the reinstated side connections, corporation stops, etc. shall be capped or otherwise isolated. When sections of rehabilitated piping are reconnected with new spool pieces, all flange connections shall be made watertight for the pressure test so that any leakage can be attributed to the rehabilitated piping.
4. The pipe section to be tested shall be isolated with blind flanges or another appropriate restrained and gasketed method rated for the required test pressure. The means for temperature measurement, air relief, and filling of the test section with water shall be provided. Valves can be used to fill a test section provided that the line can be isolated and no leakage is evident when the valves are closed.
5. Termination points, elbows, and other fittings that may be removed shall be adequately braced, blocked and supported for the duration of the test and the test pressure shall not exceed the safe pressure for such conditions.
6. The test section shall be filled slowly from an available water source. All air should be expelled from the pipeline during filling, since trapped air may compress during pressurization giving erroneous leakage measurements. When filling the pipeline with water, all air release valves and the high elevation end of the pipeline shall be opened until a free flow of water is visible, to verify the release of all air from the pipeline to be tested. The rate of filling should not significantly pressurize the pipeline prematurely.
7. Once the pipe is filled, the specified test pressure, based on the elevation of the lowest point of the line or section under test and corrected to the elevation of the test gauge, shall be applied by means of a pump connected to the pipe in a manner satisfactory to the OWNER. The test pressure shall be applied in steps at intervals of 50 psi or one-half of the test pressure, whichever is less, until the required test pressure is reached. The pressure shall be held at each step for a minimum of 30 minutes.
8. A minimum stabilization period of 2 to 3 hours is recommended before starting the pressure test to account for the possibility of factors such as trapped air and temperature fluctuation that could otherwise falsely indicate leakage. During this time, the test pressure shall be maintained within close proximity of the required test pressure. Decreasing make-up water during the stabilization period should indicate that one or more of these factors is present and is gradually being counteracted.
9. The test shall be one hour in duration, following the stabilization period. The test shall be initiated at the required test pressure, and after one hour, the amount of make-up water needed to return to the required pressure shall be quantified.
10. The test shall require that the quantified make-up water for the test shall not exceed 20 gallons per inch-diameter, per mile of pipe, per 24-hour day (20 GPDIM). Quantified make-up water for the test shall be extrapolated to the 24-hour rate for comparison purposes. Any visible leakage at termination points

shall be eliminated. If the leakage exceeds the allowable, the CONTRACTOR shall endeavor to locate the source of the leakage and reduce it in a manner acceptable to the OWNER. The pressure test for water-tightness shall be deemed acceptable if that actually measured during the test (extrapolated to a 24-hour rate) is equal to or less than the allowable make-up water rate of 20 GPDIM.

C. Video Inspection

1. Video inspection and recording of the installed liner shall be conducted after installation. Video results shall be reviewed and accepted by the OWNER prior to the pipeline being reconnected.
2. The work consists of furnishing all labor, materials, accessories, equipment, tools, transportation, services and technical competence for performing all operations required to execute the internal closed-circuit television survey to inspect the entire pipeline.
3. The television camera used for the survey shall be one specifically designed and constructed for such survey and shall be of the pan-and-tilt type. Lighting for the camera shall be suitable to allow a clear picture of the entire periphery of the pipe. The camera shall be operative in submerged conditions. The camera, television monitor, and other components of the video system shall be capable of producing a high resolution color video picture. The CONTRACTOR shall maintain camera in clear focus at all times. Picture quality and definition shall be to the satisfaction of the OWNER; and if unsatisfactory, equipment shall be removed and replaced with adequate equipment.
4. The video camera shall include a title feature capable of showing on the recorded video the following information:
 - a. City and State
 - b. Date
 - c. Contractor's Name
 - d. Project Name and/or Work Order Number
 - e. Line Size
 - f. On-going Footage Counter
5. All video recordings shall be submitted to the OWNER and will become the property of the OWNER.
6. Video reports or logs are to be neat and completely filled out and submitted to the OWNER along with the recorded video.
7. The camera shall be moved through the line in either direction at a moderate rate, stopping when necessary to permit proper documentation of the liner's condition. In no case shall the television camera be operated at a speed greater than 30 feet per minute.

8. The purpose of recording shall be to supply a visual and audio record of the entire line, specifically including any problem areas, which may be replayed and reviewed. Once videotaped, the tapes become property of the OWNER. The CONTRACTOR shall have all video and necessary playback equipment readily accessible for review by the OWNER during the project.

3.10 CLEAN-UP

- A. Upon acceptance of the installation, the Contractor shall reinstate, to original conditions, the project area affected by the operations.

- END OF SECTION –

SECTION 02934 - SODDING

PART 1 -- GENERAL

1.01 SCOPE

- A. Provide all labor, materials and equipment necessary for complete sodding of areas affected by construction. This shall include, but not be limited to: liming, fertilizing, sodding, necessary barriers, tests and all incidentals to make the work complete.

1.02 WORK INCLUDED

- A. Testing of topsoil.
- B. Raking and leveling topsoil as required for sodding.
- C. Liming and fertilizing of topsoil.
- D. Laying and rolling of sod.
- E. Maintaining sod.

1.03 SUBMITTALS

- A. Submit product source and information sheets in accordance with Section 01300, "Submittals".

PART 2 -- PRODUCTS

2.01 MATERIALS

- A. Fertilizer
 - 1. Fertilizer shall be commercial fertilizer, as manufactured by International Chemical Company or equal.
 - 2. Said fertilizer shall have a 10-20-6 N.P.K. content and contain a minimum of 60% of organic material.
 - 3. It shall be delivered at the site in the original sealed containers.
- B. Sod
 - 1. Sod from right-of-way swales within the work area shall be Bahia sod or replaced in-kind, whichever is finer quality.
 - 2. St. Augustine sod will be used for areas with irrigation systems and in locations with similar existing turf.
 - 3. Sod shall be first quality sod of firm texture having a compacted growth and good root development.

4. Sod shall be absolutely true to varietal type, live, fresh and free from weeds or objectionable vegetation, fungus, insects and disease of any kind. Sod shall be kept moist from the time it is field cut until it is laid at the proposed site.
5. The sod shall be as grown by a certified turf nursery and CONTRACTOR shall inform ENGINEER as to the source of the sod to be utilized prior to ordering and delivery of sod.
6. Sod shall be furnished and installed in rectangular sod strips measuring 12 to 16-inches in width of standard lengths of not less than 2 feet and delivered on pallets.

PART 3 -- EXECUTION

3.01 INSTALLATION

- A. These areas shall be fine graded to achieve the finished subgrade after compaction which shall be obtained by rolling, dragging or by an approved method which obtains an equivalent compaction to that produced by a hand roller weighing from 75 to 100 pounds per foot of width. All depressions caused by settlement or rolling shall be filled with additional existing or furnished topsoil and regraded and prepared as specified above until it presents a reasonably smooth and even finish at the required sod sub-grade.
- B. All sod furnished shall be living sod containing at least 70% of thickly matter grasses as specified and free from noxious weeds. All sod shall be certified free of fire ants.
- C. No broken pads or torn or uneven ends will be accepted. Standard size sections of sod shall be strong enough to support own weight and retain their size and shape when suspended vertically with a firm grasp on the upper 10% of the section. Sod shall not be harvested when its moisture content (excessively wet or dry) may adversely affect its survival.
- D. Sod shall be harvested, delivered, and installed within a period of 24 hours. Sod not installed within this time period shall be subject to inspection and rejection by ENGINEER, and shall be removed from the site and a fresh sod supply shall be furnished at no extra cost to CITY.
- E. The topsoil shall not be moist at time of installation; however, it shall contain sufficient moisture so as not be powdery or dusty, both as determined by the supplier's representative.
- F. The overlapping of existing lawn with new sod along limit of work lines will not be permitted. Sod shall be laid in strips, edge to edge, with the lateral joints staggered. All minor or unavoidable openings in the sod shall be closed with sod plugs or with topsoil, as directed by ENGINEER. However, sod laid with joints determined to be too large shall be lifted and re-laid as specified herein at no extra cost to CITY.

- G. Immediately after the sod is laid, the sod shall be watered thoroughly by hand or mechanical sprinkling until the sod and at least 2-inch of the top soil bed have been thoroughly moistened.
- H. CONTRACTOR shall be responsible to furnish his own supply of water to the site at no extra cost. If possible, CITY shall furnish CONTRACTOR, upon request, with a source and supply of water. CONTRACTOR shall apply for temporary meter and pay CITY for water used at current utility billing rates. However, if CITY's water supply is not available or not functioning, CONTRACTOR shall be responsible to furnish adequate supplies at his own cost. All work injured or damaged due to the lack of, or the use of too much water, shall be CONTRACTOR's responsibility to correct.

3.02 MAINTENANCE

- A. Maintain the entire sodded areas at least a 30-day period or until final acceptance at the completion of the Contract, whichever is longer. Maintenance shall include watering as specified, weeding and removal of stones which may appear. All bare or dead spots which become apparent shall be properly prepared, limed and fertilized, and resodded at CONTRACTOR's expense as many times as necessary to secure a good growth. In the event that the sod installation is not accepted by ENGINEER, the entire area shall be maintained and cut by CONTRACTOR until final acceptance of the sod installation.
- B. Take whatever measures are necessary to protect the sod while it is developing. These measures shall include furnishing of warning signs, barriers, or any other necessary measures of protection.

- END OF SECTION -

DIVISION 3 – CONCRETE

SECTION 03100 - CONCRETE FORMWORK

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The CONTRACTOR shall design and furnish all materials for concrete formwork, bracing, and supports and shall design and construct all falsework, all in accordance with the provisions of the Contract Documents.

1.02 RESPONSIBILITY

- A. The design and engineering of the formwork as well as safety considerations are the responsibility of the CONTRACTOR.

1.03 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 01300 - Submittals
- B. Section 03200 - Concrete Reinforcement
- C. Section 03300 - Cast-in-Place Concrete
- D. Section 03315 - Grout

1.04 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Without limiting the generality of other requirements of these Specifications, all work specified herein shall conform to or exceed the requirements of the Building Code and 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. Codes and Standards

- a. The Building Code, as referenced herein, is the Florida Building Code (FBC).

2. Government Standards

- a. PS 1 U.S. Product Standard for Concrete Forms, Class I.

3. Commercial Standards

- a. ACI 347 Recommended Practice for Concrete Formwork.
- b. ACI 318 Building Code Requirements for Reinforced Concrete.
- c. ACI 350 Code Requirements for Environmental Engineering Concrete Structures

1.05 QUALITY ASSURANCE

- A. The variation from established grade or lines shall not exceed 1/4 inch in 10 feet and there shall be no offsets or visible bulges or waviness in the finished surface. All tolerances shall be within the "Suggested Tolerances" specified in ACI 347. The CONTRACTOR shall grind smooth all fins and projections between formwork panels as directed by the ENGINEER.
- B. Curved forms shall be used for curved and circular structures that are cast-in-place. Straight panels will not be acceptable for forming curved structures.

PART 2 -- PRODUCTS

2.01 FORM MATERIALS

- A. Except as otherwise expressly accepted by the ENGINEER, all lumber brought on the job site for use as forms, shoring, or bracing shall be new material. All forms shall be smooth surface forms and shall be of the following materials:

Footing sides	-Construction grade Southern Pine or plywood.
Walls	-Steel or plywood panel
Columns	-Steel, plywood or fiber glass
Roof and floor Slabs	-Plywood
All other work	-Steel panels, plywood or tongue and groove lumber

- B. Materials for concrete forms, formwork, and falsework shall conform to the following requirements:
 - 1. Lumber shall be Southern Pine, construction grade or better, in conformance with U.S. Product Standard PS20.
 - 2. Plywood for concrete formwork shall be new, waterproof, synthetic resin bonded, exterior type Douglas Fir or Southern Pine plywood manufactured especially for concrete formwork and shall conform to the requirements of PS I 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.

2.02 PREFABRICATED FORMS

- A. Form materials shall be metal, wood, plywood, 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. Metal forms shall be an acceptable type that will accomplish such results. Wood forms for surfaces to be painted shall be Medium Density Overlaid plywood, MDO Ext. Grade.

2.03 FORMWORK ACCESSORIES

- A. Exterior corners in concrete members shall be provided with 3/4-inch chamfers. Re-entrant corners in concrete members shall not have fillets unless otherwise shown.
- B. 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 1-1/2 inches; and all such fasteners shall be such as to leave holes of regular shape for reaming.

- C. Form ties for water-retaining structures shall have integral waterstops. Removable taper ties may be used when acceptable to the ENGINEER. At locations where removable taper ties are acceptable, 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 Greenstreak Group, Inc., or approved equal. Friction fit plugs shall not be used.
- D. 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 and shall be compatible with specified coatings. 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 EXAMINATION

- A. Forms to confine the concrete and shape it to the required lines shall be used wherever necessary. The CONTRACTOR shall assume full responsibility for the adequate design of all forms, and any forms which are unsafe or inadequate in any respect shall promptly be removed from the Work and replaced at the CONTRACTOR's expense. A sufficient number of forms of each kind shall be provided to permit the required rate of progress to be maintained. The design and inspection of concrete forms and falsework, shall comply with applicable local, state and Federal regulations. 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.
- B. Concrete forms shall conform to the shape, lines, and dimensions of members as called for on the Drawings, and shall be substantially, free from surface defects, and sufficiently tight to prevent leakage. Forms shall be properly braced or tied together to maintain their position and shape under a load of freshly-placed concrete.
- C. All forms shall be true in every respect to the required shape and size, shall conform to the established alignment and grade, and 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. 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. Plywood, 5/8 inch and greater in thickness, may be fastened directly to studding if the studs are spaced close enough to prevent visible deflection marks in the concrete. The forms shall be tight so as 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. Adequate clean-out holes shall be provided at the bottom of each lift of forms. The size, number, and location of such clean-outs shall be as acceptable to the ENGINEER.

- D. Concrete construction joints will 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 affect whatsoever on the concrete. Pipe stubs and anchor bolts shall be set in the forms where required.

3.02 EARTH FORMS

- A. Earth forms will not be permitted.

3.03 FOOTINGS, SLAB EDGES AND GRADE BEAMS

- A. Provide wood side forms for all footings, slab edges and grade beams.

3.04 APPLICATION - FORM RELEASE AGENT

- A. Apply form release agent on formwork in accordance with manufacturer's recommendations.

3.05 INSERTS, EMBEDDED PARTS AND OPENINGS

- A. Embedded Form Ties: Holes left by the removal of form tie cones shall be reamed with suitable toothed reamers so as to leave the surface of the holes clean and rough before being filled with mortar as specified for in Section 03350 entitled "Concrete Finishes". Wire ties for holding forms will not be permitted. 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 members. The use of snap-ties which cause spalling of the concrete upon form stripping or tie removal will not be permitted. 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. Where metal rods extending through the concrete are used to support or to strengthen forms, the rods shall remain embedded and shall terminate not less than 1-inch back from the formed face or faces of the concrete.

3.06 FORM CLEANING

- A. 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 on all exposed concrete surfaces. Exposed concrete surfaces are defined as surfaces which are permanently exposed to view. Unused tie rod holes in forms shall be covered with metal caps or shall be filled by other methods acceptable to the ENGINEER.

3.07 FORMWORK TOLERANCES

- A. Formwork shall be constructed to ensure that finished concrete surfaces will be in accordance with the tolerances listed in ACI 347.

1. The following construction tolerances are hereby established and apply to finished walls and slab unless otherwise shown in the Drawings:
 1. Variation from plumb:
 - A. In the lines and surfaces of columns, piers, walls, and in arises:

In any 10 ft of length-----	1/4 in.
Maximum for the entire length-----	1 in.
 - B. For exposed corner columns, control-joint grooves, and other conspicuous lines:

In any 20 ft length -----	1/4 in.
Maximum for the entire length-----	1/2 in.
 2. Variations from the level or from the grades specified in the contract documents:
 - A. In slab soffits, ceilings, beam soffits and in arises, measured before removal of supporting shores:

In any 10 ft of length-----	1/4 in.
In any bay or in 20 ft length -----	3/8 in.
 - B. In exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines:

In any bay or in 20 ft length -----	1/4 in.
Maximum for the entire length-----	1/2 in.
 3. Variation of the linear building lines from established position in plan and related position of columns, wall, and partitions:

In any bay -----	1/2 in.
In any 20 ft of length-----	1/2 in.
Maximum for the entire length -----	1 in.
 4. Variation in the sizes and location of sleeves, floor openings, and wall openings----- $\pm 1/4$ in.
 5. Variation in cross-sectional dimensions of columns and beams and in the thickness of slabs and walls:

Minus -----	1/4 in.
Plus-----	1/2 in.
 6. Footings^{*}
 - A. Variations in dimensions in plan:

Minus -----	1/2 in.
Plus -----	2 in.
 - B. Misplacement or eccentricity

2 percent of the footing width in the direction of misplacement but not more than-----	2 in.
--	-------
 - C. Thickness:

Decrease in specified thickness ----- 5 percent
Increase in specific thickness----- No limit

7. Variation in steps:

A. In a flight of stairs:

Rise ----- $\pm 1/8$ in.

Tread ----- $\pm 1/4$ in.

B. In consecutive steps:

Rise ----- $\pm 1/16$ in.

Tread ----- $\pm 1/8$ in.

**Tolerances apply to concrete dimensions only, not to positioning of vertical reinforcing steel, dowels, or embedded items.*

3.08 FORM REMOVAL

A. Remove top forms on sloping surfaces of concrete as soon as removal operations will not allow the concrete to sag. Perform any needed repairs or treatments required on sloping surfaces at once, and follow immediately with the specified curing.

B. The CONTRACTOR shall be responsible for the removal of forms and shores. Forms or shores shall not be removed before test cylinders have reached 75% of the specified minimum 28 day compressive strength for the class of concrete specified in Section 03300 entitled "Cast-in-Place Concrete", nor sooner than listed below:

1. Foundation slab and grade beam side forms3 days
2. Wall forms3 days
3. Column forms.....3 days
4. Overhead beam and girder side forms3 days
5. Overhead beam bottoms and slab forms/shores14 days

3.09 MAINTENANCE OF FORMS

A. Forms shall be maintained at all times in good condition, particularly as to size, shape, strength, rigidity, tightness, and smoothness of surface. Forms, when in place, shall conform to the established alignment and grades. Before concrete is placed, the forms shall be thoroughly cleaned. The form surfaces shall be treated with a nonstaining mineral oil or other lubricant acceptable to the ENGINEER and compatible with finishes, coatings and paints. Any excess lubricant shall be satisfactorily removed before placing the concrete. Where field oiling of forms is required, the CONTRACTOR shall perform the oiling at least two weeks in advance of their use. Care shall be exercised to keep oil off the surfaces of steel reinforcement and other metal items to be embedded in concrete.

- END OF SECTION -

SECTION 03200 - CONCRETE REINFORCEMENT

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The CONTRACTOR shall furnish, fabricate and place all concrete reinforcing steel, welded wire fabric, couplers, and concrete inserts for use in reinforced concrete and shall perform all appurtenant work, including all the wires, clips, supports, chairs, spacers, and other accessories and special work necessary to hold the reinforcing steel in place and protect it from injury and corrosion, all in accordance with the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 01300 - Submittals
- B. Section 03100 - Concrete Formwork
- C. Section 03300 - Cast-in-Place Concrete
- D. Section 03315 - Grout

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 or exceed the requirements of the Building Code and 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. Codes and Standards

- a. The Building Code, as referenced herein, is the Florida Building Code (FBC).

2. Commercial Standards

- a. ACI 315 Details and Detailing of Concrete Reinforcement.
- b. CRSI Concrete Reinforcing Steel Institute Manual of Standard Practice
- c. ACI SP66 ACI Detailing Manual
- d. ACI 305 Hot Weather Concreting
- e. ACI 318 Building Code Requirements for Reinforced Concrete.
- f. ACI 350 Code Requirements for Environmental Engineering Concrete Structures
- g. WRI Manual of Standard Practice for Welded Wire Fabric.

- h. ASTM A 1064 Specification for Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
- i. ASTM A 615 Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.

1.04 SUBMITTALS

- A. The CONTRACTOR shall furnish shop bending diagrams, placing lists, and Drawings of all reinforcing steel prior to fabrication in accordance with the requirements of the Section 01300 entitled, "Submittals." The CONTRACTOR shall submit detailed placing and shop fabricating drawings, prepared in accordance with ACI 315 and ACI Detailing Manual - (SP66) for all reinforcing steel. These drawings shall be made to such a scale as to clearly show joint locations, openings, the arrangement, spacing and splicing of the bars. Where opening sizes are dependent on equipment selection the CONTRACTOR shall indicate all necessary dimensions to define steel lengths and placing details.
- B. Details of the concrete reinforcing steel and concrete inserts shall be submitted by the CONTRACTOR at the earliest possible date after receipt by the CONTRACTOR of the Notice to Proceed. Said details of reinforcing steel for fabrication and erection shall conform to ACI 315 and the requirements specified and shown. The shop bending diagrams shall show the actual lengths of bars, to the nearest inch measured to the intersection of the extensions (tangents for bars of circular cross section) of the outside surface. The shop Drawings shall include bar placement diagrams which clearly indicate the dimensions of each bar splice.
- C. Where mechanical couplers are shown on the Drawings to be used to splice reinforcing steel, the CONTRACTOR shall submit manufacturer's literature which contains instructions and recommendations for installation for each type of coupler used; certified test reports which verify the load capacity of each type and size of coupler used; and shop Drawings which show the location of each coupler with details of how they are to be installed in the formwork.
- D. Requests to relocate any bars that cause interferences or that cause placing tolerances to be violated.
- E. Proposed supports for each type of reinforcing.
- F. Certification that all installers of dowel adhesives are certified as Adhesive Anchor Installers in accordance with the ACI-CRSI Anchor Installer Certification Program.
- G. Certification of dowel adhesive installer training.
- H. International Code Council-Evaluation Services Evaluation Services Report (ICC-ES ESR) for dowel adhesives.
- I. Adhesive dowel testing plan.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications for Drilled-In Rebar: Drilled-in rebar shall be installed by an Installer with at least three years of experience performing similar installations. Installer shall be certified as an Adhesive Anchor Installer in accordance with ACI-CRSI Adhesive Anchor Installation Certification Program.
- B. Installer Training: 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 for drilled-in anchors, 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. Rebar doweling preparation and installation.
 - 5. Proof loading/torquing.
- C. 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 inspection of products and anchor holes prior to injection, installation, and proof testing.

PART 2 -- PRODUCTS

2.01 REINFORCEMENT

- A. All reinforcing steel for all reinforced concrete construction shall conform to the following requirements:
 - 1. Bar reinforcement shall conform to the requirements of ASTM A 615 for Grade 60 Billet Steel Reinforcement, and shall be manufactured in the United States. All reinforcing steel 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 the Drawings.
 - 2. Welded wire fabric reinforcement shall conform to the requirements of ASTM A 185 and the details shown on the Drawings; provided, that welded wire fabric with longitudinal wire of W9.5 size wire shall be either furnished in flat sheets or in rolls with a core diameter of not less than 10 inches; and provided further, that welded wire fabric with longitudinal wires larger than W9.5 size shall be furnished in flat sheets only. All welded wire fabric reinforcement shall be galvanized.
- B. Field welding of reinforcing steel will not be allowed.
- C. Use of coiled reinforcing steel will not be allowed.

2.02 ACCESSORY MATERIALS

- 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. Tie Wire: Galvanized 16 gauge annealed type.
- D. Concrete blocks (dobies), used to support and position reinforcing steel, shall have the same or higher compressive strength as specified for the concrete in which it is located. Concrete blocks shall only be used bottom mat of reinforcing steel for slabs on grade.

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 with a carbide bit unless otherwise recommended by the manufacturer. If coring holes is allowed by the manufacturer and approved by the Engineer, cored holes shall be roughened in accordance with manufacturer 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 either dry or water-saturated. 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 show on the Drawings. Although all manufacturers listed below are permitted, the embedment depth shown on the Drawings is based on "SET-XP" by Simpson Strong-Tie Co. 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 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, embedment depths stated in the manufacturer's ICC-ES ESR.
- 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, must comply with the latest revision of ICC-ES Acceptance Criteria AC308, and shall have a valid ICC-ES report. The adhesive system shall be "Epcon System C6+ Adhesive Anchoring System" as manufactured by ITW Redhead, " HIT-HY 200 Injection Adhesive Anchor System" as manufactured by Hilti, Inc. "SET-XP" as manufactured by Simpson Strong-Tie Co. or "Pure 110+ Epoxy Adhesive Anchor System" by Powers Fasteners. Fast-set epoxy formulations shall not be acceptable.
- I. All individuals installing dowel adhesive system shall be certified as an Adhesive Anchor Installer in accordance with the ACI-CRSI Anchor Installation Certification Program.

2.05 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. Stirrups and tie bars shall be bent around a pin having a diameter not less than 1-1/2 inch for No. 3 bars, 2-inch for No. 4 bars, and 2-1/2 inch for No. 5 bars. Bends for other bars shall be made around a pin having a diameter not less than 6 times the minimum thickness, except for bars larger than 1 inch, in which case the bends shall be made around a pin of 8 bar diameters. Bars shall be bent cold.
- B. The CONTRACTOR shall fabricate reinforcing bars for structures in accordance with bending diagrams, placing lists, and placing Drawings. Said Drawings, diagrams, and lists shall be prepared by the CONTRACTOR as specified under Section entitled "Submittals," herein.
- C. Fabricating Tolerances: Bars used for concrete reinforcing shall meet the following requirements for fabricating tolerances:
1. Sheared length: + 1 inch

2. Depth of truss bars: + 0, - 1/2 inch
3. Stirrups and ties: + 1/2 inch
4. All other bends: + 1 inch
- D. Welded splice shall be provided where required on the drawings. All welded splices of reinforcing steel shall develop a tensile strength which exceeds 125 percent of the yield strength of the reinforcing bars which are connected.
- E. All materials required to perform the welded splices to the requirements of AWS D1.4 shall be provided.

PART 3 -- EXECUTION

3.01 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 be protected from the weather at all times by suitable covering. It shall be stored in an orderly manner and plainly marked to facilitate identification.
- C. Reinforcing steel shall at all times 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 there is delay in depositing concrete, reinforcing shall be reinspected and if necessary recleaned.

3.02 TEMPERATURE REINFORCEMENT

- A. Unless otherwise shown on the Drawings or in the absence of the steel being shown, the minimum cross sectional area of reinforcing steel in the direction of principal reinforcement shall be 0.0033 times the gross concrete area of all concrete members.
- B. Unless otherwise shown on the Drawings or in the absence of the steel being shown, the minimum cross sectional area of temperature reinforcing steel (reinforcing steel perpendicular to the principal reinforcing steel) shall be as follows:
 1. 0.0020 times the gross concrete area in slabs of non-water-bearing structures.
 2. 0.0015 times the gross concrete area vertically in walls of non-water-bearing structures.
 3. 0.0025 times the gross concrete area horizontally in walls of non-water-bearing structures.

4. 0.0050 times the gross concrete area in slabs of water-bearing structures
5. 0.0030 times the gross concrete area vertically in walls of water-bearing structures.
6. 0.0050 times the gross concrete area horizontally in walls of water-bearing structures.
7. Temperature steel shall not be spaced further apart than five times the slab or wall thickness, nor more than 18 inches.

3.03 PLACEMENT

- 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 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 bars without settlement, but in no case shall such support be continuous. All concrete blocks used to support reinforcing steel shall be tied to the steel with wire ties which are embedded in the blocks. For concrete over formwork, the Contractor shall furnish concrete, metal, plastic, or other acceptable bar chairs and spacers.
- 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 in order to provide the specified concrete coverage.
- D. Bars additional to those shown on the Drawings which may be found necessary or desirable by the Contractor for the purpose of securing reinforcement in position shall be provided by the Contractor at its own expense.
- E. Unless otherwise specified, reinforcement placing tolerances shall be within the limits specified in Section 7.5 of ACI 318 except where in conflict with the requirements of the Building Code.
- F. Bars may be moved as necessary to avoid interference with other reinforcing steel, conduits, or embedded items. If bars are moved more than one bar diameter, or enough to exceed the above tolerances, the resulting arrangement of bars shall be as acceptable to the Engineer. Reinforcing bars shall not be cut to place electrical plumbing or mechanical conduits, piping, ducts, etc. without the expressed written approval of the Engineer of Record.
- G. Welded wire fabric reinforcement placed over horizontal forms shall be supported on slab bolsters having gray, plastic-coated standard type legs as specified in Paragraph B herein. Slab bolsters shall be spaced not less than 30 inches on centers, shall extend continuously across the entire width of the reinforcing mat, and shall support the reinforcing mat in the plane shown on the Drawings.
- H. Welded wire fabric placed over the ground shall be supported on wired concrete blocks (dobies) spaced not more than 3 feet on centers in any direction. The construction practice

of placing welded wire fabric on the ground and hooking into place in the freshly placed concrete shall not be used.

- I. The clear distance between parallel bars (except in columns and between multiple layers of bars in beams) shall be not less than the nominal diameter of the bars nor less than 1-1/3 times the maximum size of the coarse aggregate, nor less than one inch.
- J. Where reinforcement in beams or girders is placed in 2 or more layers, the clear distance between layers shall be not less than one inch.
- K. In columns, the clear distance between longitudinal bars shall be not less than 1-1/2 times the bar diameter, nor less than 1-1/2 times the maximum size of the coarse aggregate, nor less than 1-1/2 inches.
- L. The clear distance between bars shall also apply to the distance between a contact splice and adjacent splices or bars.
- M. Reinforcing bar splices shall only be used at locations shown on the Drawings. When it is necessary to splice reinforcement at points other than where shown, the character of the splice shall be as acceptable to the Engineer.
- N. The length of lap for reinforcing bars, unless otherwise shown on the Drawings shall be in accordance with ACI 318, Section 12.15.1 for a class B splice.
- O. Laps of welded wire fabric shall be in accordance with the 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.
- P. 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 completely 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.
- Q. Reinforcing shall not be straightened or rebent in a manner which will injure the material. Bars with kinks or bends not shown on the Drawings shall not be used. All bars shall be bent cold, unless otherwise permitted by the Engineer. No bars partially embedded in concrete shall be field-bent except as shown on the Drawings or specifically permitted by the Engineer.
- R. 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.
- S. 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 the value indicated on the Drawings, with a minimum of one tested dowel per group. If no test value is indicated on the Drawings but the installed dowel is under direct tension, the Contractor shall notify the Engineer to verify the required test value.
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. The testing equipment shall have a minimum of three support points and shall be of sufficient size to locate the edge of supports no closer than two times the anchor embedment depth from the center of the anchor.
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 of Florida. 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 proof test. Concrete cracking in the vicinity of the dowel after loading shall be considered a failure. Dowels exhibiting damage shall be removed and replaced. If more than 5 percent of tested dowels fail, then 100 percent of dowels shall be proof tested.
5. Proof 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 CLEANING AND PROTECTION

- A. Reinforcing steel shall at all times be protected from conditions conducive to corrosion until concrete is placed around it.
- B. 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 there is delay in depositing concrete, reinforcing shall be reinspected and, if necessary recleaned.

- END OF SECTION -

SECTION 03290 - JOINTS IN CONCRETE

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The CONTRACTOR shall construct all joints in concrete at the locations shown on the Drawings. Joints required in concrete structures are of various types and will be permitted only where shown on the Drawings, unless specifically accepted by the ENGINEER.
- B. Construction joints, expansion joints, contraction joints and control joints shall be provided at the locations shown and formed in accordance with the details shown on the Drawings.
- C. Waterstops shall be provided where shown on the Drawings, and in all waterbearing joints in hydraulic structures.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 03100 - Concrete Formwork
- B. Section 03200 - Concrete Reinforcement
- C. Section 03300 - Cast-in-Place Concrete.
- D. Section 03315 - Grout
- E. Section 03350 - Concrete Finishes
- F. Section 03370 - Concrete Curing
- G. Section 07920 – Sealants and Caulking

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 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. Federal Specifications:
TT-S-00227E(3)
Sealing Compound, Elastomeric Type, Multi-component (For Caulking, Sealing, and Glazing Buildings and Other Structures).
 - 2. U.S. Army Corps of ENGINEERs Standard Specifications
CRD-C572
 - 3. Commercial Standards:

ASTM C 920

Specification for Elastomeric Joint Sealants.

ASTM D 624

Test Method for Rubber Property -- Tear Resistance.

ASTM D 638

Test Method for Tensile Properties of Plastics.

ASTM D 746

Test Method for Brittleness Temperature of Plastics and Elastomers by Impact.

ASTM D 747

Test Method for Apparent Bending Modules of Plastics by Means of a Cantilever Beam.

ASTM D 1752

Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.

ASTM D 2240

Test Method for Rubber Property -- Durometer Hardness.

1.04 TYPES OF JOINTS

- A. Construction Joints: When fresh concrete is placed against a hardened concrete surface, the joint between the two pours is called construction joint. Unless noted otherwise, all joints in water bearing structures shall be provided with a waterstop of the shape specified herein or shown on the Drawings.
- B. Contraction Joints: Contraction joints are similar to construction joints except that the fresh concrete shall not bond to the hardened surface of the first pour, which shall be coated with a bond breaker. The slab reinforcement shall be stopped 4-1/2 inches from the joint; which is provided with a sleeve-type dowel, to allow shrinkage of the concrete of the second pour. Waterstop and/or sealant groove shall also be provided when specified on the Drawings.
- C. Expansion Joints: To allow the concrete to expand freely, a space is provided between the two pours, the joint shall be formed as detailed on the Drawings. This space is obtained by placing a preformed joint filler against the first pour, which acts as a form for the second pour. Unless noted otherwise, all expansion joints in water bearing members shall be provided with a 9-inch wide waterstop. Preformed joint filler shall be installed with the edge at the indicated distance below or back from finished concrete surface, and shall have a slightly tapered, dressed, and oiled wood strip secured to or placed at the edge thereof during concrete placement, which shall later be removed to form space for sealing material.

The space so formed shall be filled with a joint sealant material as specified herein. The joint sealant shall be isolated from the filler using a bond breaker.

- D. Control Joints: The function of the control joint is to provide a weaker plane in the concrete, where shrinkage cracks will probably occur. A groove, of the shape and dimensions shown on the Drawing, is formed or saw-cut in the concrete. This groove shall be filled with a joint sealant.

1.05 SUBMITTALS

- A. Waterstops: Prior to production of the material required under this contract, qualification samples shall be submitted. Such samples shall consist of extruded or molded sections of each size or shape to be used, and shall be accomplished so that the material and workmanship represents, in all respects, the material to be furnished under this contract. The balance of the material to be used under this contract shall not be produced until after the ENGINEER has reviewed the qualification samples. The samples shall be delivered to a location on site indicated by the ENGINEER.
- B. Joint Sealant: Prior to ordering the sealant material, the CONTRACTOR shall submit to the ENGINEER for the ENGINEER's review, sufficient data to show general compliance with the requirements of the Contract Documents.
- C. CONTRACTOR shall submit product data sheets of all materials proposed under this section.
- D. Shipping Certification: The CONTRACTOR shall provide written certification from the manufacturer as an integral part of the shipping form, to show that all of the material shipped to this project meets or exceeds the physical property requirements of the Contract Documents. CONTRACTOR certificates are not acceptable.
- E. The CONTRACTOR shall submit placement Shop Drawings showing the location and type of all joints for each structure.

1.06 QUALITY ASSURANCE

- A. Waterstop
 - 1. Review: It is required that all waterstop field joints shall be subject to review inspection, and no such work shall be scheduled or started without having made prior arrangements with the ENGINEER to provide for the required reviews. Not less than 24 hours' notice shall be provided to the ENGINEER for scheduling such reviews.
 - 2. All field joints in waterstops will be subject to rigid review for misalignment, bubbles, inadequate bond, porosity, cracks, offsets, 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 its own expense.

3. The following defects represent a partial list of defects which shall be grounds for rejection:
 - a. Offsets at joints greater than 1/16 inch or 15 percent material thickness, at any point, whichever is less.
 - b. Exterior crack at joint, due to incomplete bond, deeper than 1/16 inch or 15 percent of material thickness, at any point, whichever is less.
 - c. Any combination of offset or exterior crack which will result in a net reduction in the cross section of the waterstop in excess of 1/16 inch or 15 percent of material thickness at any point, whichever is less.
 - d. Misalignment of joint which result in misalignment of the waterstop in excess of 1/2 inch in 10 feet.
 - e. Porosity in the welded joint as evidenced by visual inspection.
 - f. Bubbles or inadequate bonding which can be detected with pen-knife test. (If, while prodding the entire joint with the point of a pen knife, the knife breaks through the outer portion of the weld into a bubble, the joint shall be considered defective.)

1.07 GUARANTEE

- A. The CONTRACTOR shall provide a two-year written guarantee of the entire sealant installation against faulty and/or incompatible materials and workmanship, together with a statement that it agrees to repair or replace, to the satisfaction of the CITY, at no additional cost to the CITY, any such defective areas which become evident within said two-year guarantee period.

PART 2 -- PRODUCTS

2.01 PVC WATERSTOPS

- A. General: Waterstops shall be extruded from an elastomeric polyvinylchloride compound containing the plasticizers, resins, stabilizers, and other materials necessary to meet the requirements of these Specifications. No reclaimed or scrap material shall be used. The CONTRACTOR shall obtain from the waterstop manufacturer and shall furnish to the ENGINEER for review, current test reports and a written certification of the manufacturer that the material to be shipped to the job meets the physical requirements as outlined in the U.S. Army Corps of ENGINEERS Specification CRD-C572 and listed in Paragraph C. below.
- B. Multi-Rib Waterstops: All PVC waterstops shall be of Multi-rib construction of the following types:
 1. Expansion Joints and Control Joints: 9-inches by 3/8-inch minimum thickness, ribbed center bulb. Waterstops for expansion joints and control joints shall be Style 738 by Greenstreak or equal .

2. All other Construction Joints: 6-inches by 3/8-inch minimum thickness, flat ribbed. Waterstops for all construction joints shall be serrated style 732 by Greenstreak or equal .
3. Install Waterstops as shown as manufactured structures .
4. T-type Waterstops installed against existing concrete shall be Style 609 by Greenstreak, or equal. Compatible batten bars and anchor bolts shall be supplied by the same manufacturer .
5. Provide factory made waterstop fabrications for all changes of direction, intersections, and transitions leaving only straight butt joint splices for the field .
6. Provide hog rings or grommets spaced at 12 inches on center along length of waterstop.

C. Waterstop Testing Requirements: When tested in accordance with the specified test standards, the waterstop material shall meet or exceed the following requirements:

	<u>Value</u>	<u>ASTM Std.</u>
Tensile Strength-min (psi)	1750	D 638, Type IV
Ultimate Elongation-min (percent)	350	D 638, Type IV
Low Temp. Brittleness-Max (degrees F)	-35	D 746
Stiffness in Flexure-min (psi)	400	D 747
<u>Accelerated Extraction (CRD-C572)</u>		
Tensile Strength-min (psi)	1500	D 638, Type IV
Ultimate Elongation-min (percent)	300	D 638, Type IV
<u>Effect of Alkalies (CRD-C572)</u>		
Ultimate Elongation-min (percent)	300	D 638, Type IV
Change in Weight (percent)	+0.25/-0.10	----
Change in Durometer, Shore A	+5	D 2240
<u>Finish Waterstop</u>		
Tensile Strength-min (psi)	1400	D 638, Type IV
Ultimate Elongation-min (percent)	280	D 638, Type IV

2.02 CHEMICAL RESISTANT WATERSTOPS

- A. General: Waterstops shall be manufactured from thermoplastic elastomeric rubber material. The synthetic rubber shall be provide a high resistance to acids, bases, alcohols, oils, solvents or chemicals. No reclaimed material shall be used. The CONTRACTOR shall obtain from the waterstop manufacturer and furnish to the ENGINEER for review, current test reports and a written certification of the manufacturer that the material to be shipped to

the job meets the physical requirements outlined herein. Waterstop connections shall be heat welded. All waterstop corners, intersections, and directional changes shall be miter cut, heat welded, factory fabricated. Only straight butt splices shall be allowed in the field.

- B. Multi-Rib Waterstops: All chemical resistant waterstops shall be of multi-rib construction. Waterstops for expansion joints shall be 9"x3/16" ribbed with a center bulb. Waterstops for construction joints shall be 6"x3/16" ribbed with a center bulb. Chemical resistant waterstops shall be Westec Type TPE-R synthetic rubber, manufactured by Westec Barrier Technologies, St. Louis, MO, or equal.

- C. Waterstop Physical Properties: When tested in accordance with the specified test standards, the waterstop material shall meet or exceed the following requirements:

<u>Physical Property</u>	<u>Value</u>	<u>ASTM Std.</u>
Tensile Strength	1800 psi	D-412
Ultimate Elongation	450%	D-412
<u>Physical Property</u>	<u>Value</u>	<u>ASTM Std.</u>
100% Modulus	1000 psi	D-412
Shore A Hardness	85 units \pm 5 units	D-2240
Brittle Point	-70°F	D-746
Ozone Resistance	450 pphm passed	D-1171

- D. Weathering Performance: When tested in accordance with the specified test standards, the waterstop material shall meet or exceed the following requirements:

<u>Physical Property</u>	<u>Value</u>	<u>ASTM Std.</u>
Tensile Strength (% Retention)	87%	D-412
Ultimate Elongation (% Retention)	84%	D-412
Shore A Hardness (units change)	7 units	D-2240

- E. Chemical Resistance Properties: When tested in accordance with ASTM D-471 after 166 hours of full immersion at 73.4°F (23°C), the waterstop material shall meet or exceed the following requirements:

<u>Fluid</u>	<u>Physical Property</u>	<u>Value</u>
Sulfuric Acid 98%	Ultimate Elongation	77% Retention
	Ultimate Tensile	82% Retention
	100% Modulus	108% Retention
	Hardness Change Shore A	-1 Unit

	Weight Change	2.1%
<u>Fluid</u>	<u>Physical Property</u>	<u>Value</u>
Sodium Hydroxide 50%	Ultimate Elongation	101% Retention
	Ultimate Tensile	107% Retention
	100% Modulus	104% Retention
	Hardness Change Shore A	-4 Unit
	Weight Change	-0.1%

2.03 HYDROPHILIC WATERSTOPS

- A. Hydrophilic waterstops shall be designed to expand and seal under hydrostatic conditions. At construction joints, the waterstops shall be Adeka Ultraseal MC 2010 M for wall/slab thickness greater than 9 inches, and Adeka Ultraseal KBA-1510FF for wall/slab thickness less than 9 inches or equal. At expansion joints, the waterstops shall be Adeka Ultraseal KM-3030M or equal.
- B. Plate fabrications used to plug flow channels for future expansion or otherwise to close wall openings shall be caulked using hydrophilic waterstops designed for the application. Caulking agents shall be Adeka Ultraseal P201 or equal.

2.04 JOINT SEALANT

- A. Joint sealant shall comply with Section 07920 – Sealants and Caulking.

2.05 EXPANSION JOINT MATERIAL

- A. Preformed expansion joint material shall be non-extruding, and shall be one 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 D1752

2.06 BACKER ROD

- A. Backer rod shall comply with Section 07920 – Sealants and Caulking.

2.07 BOND BREAKER

- A. Bond breaker shall be Super Bond Breaker as manufactured by Burke Company, San Mateo, California; Hunt Process 225-TU as manufactured by Hunt Process Co., Santa Fe Springs, CA; Select Cure CRB as manufactured by Select Products Co., Upland, CA; or

equal. It shall contain a fugitive dye so that areas of application will be readily distinguishable.

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 CONSTRUCTION JOINTS

- A. Construction joints shall be as shown on the Drawings. Otherwise, CONTRACTOR shall submit description of the joint and its location to ENGINEER for approval.
- 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 45'-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.

3.03 SPLICES IN PVC WATERSTOPS

- A. Splices in waterstops shall be performed by heat sealing the adjacent waterstop sections in accordance with the manufacturer's printed recommendations. It is essential that:
 - 1. The material not be damaged by heat sealing.
 - 2. The splices have a tensile strength of not less than 60 percent of the unspliced materials tensile strength.
 - 3. The continuity of the waterstop ribs and of its tubular center axis be maintained.
- B. Butt joints of the ends of 2 identical waterstop sections may be made while the material is in the forms.
- C. All joints in waterstop involving more than 2 ends to be joined together, and all joints which involve an angle cut, alignment change, or the joining of 2 dissimilar waterstop sections shall be factory fabricated with not less than 24-inch long strips of material beyond the joint. Upon being inspected and accepted, such prefabricated waterstop joint assemblies shall be installed in the forms and the ends of the 24-inch strips shall be butt welded to the straight run portions of waterstop in place in the forms.

3.04 JOINT CONSTRUCTION

- A. Setting PVC Waterstops: In order to eliminate faulty installation that may result in joint leakage, particular care shall be taken of the correct positioning of the waterstops during installation. Adequate provisions must be made to support the waterstops during the progress of the Work and to ensure the proper embedment in the concrete. The symmetrical halves of the waterstops shall be equally divided between the concrete pours at the joints. The center axis of the waterstops shall be coincident with the joint openings. Maximum density and imperviousness of the concrete shall be ensured by thoroughly working it in the vicinity of all joints.
- B. In placing PVC waterstops in the forms, means shall be provided to prevent them from being folded over by the concrete as it is placed. Unless otherwise shown, all waterstops shall be held in place with light wire ties on 12-inch centers which shall be passed through the edge of the waterstop and tied to the curtain of reinforcing steel. Horizontal waterstops, with their flat face in a vertical plane, shall be held in place with continuous supports to which the top edge of the waterstop shall be tacked. In placing concrete around horizontal waterstops, with their flat face in a horizontal plane, concrete shall be worked under the waterstops by hand so as to avoid the formation of air and rock pockets.
- C. Joint Location: Construction joints, and other types of joints, shall be provided where shown on the Drawings. When not shown on the Drawings, maximum distance between horizontal joints in slabs and vertical joints in walls shall be 45-feet, and maximum distance between vertical and horizontal joints for earth or water retaining walls shall be 25-feet, unless noted otherwise. The location of all joints, of any type, shall be submitted for review by the ENGINEER.
- D. Joint Preparation: Special care shall be used in preparing concrete surfaces at joints where bonding between two sections of concrete is required. Unless otherwise shown on the

Drawings, such bonding will be required at all horizontal joints in walls. Surfaces shall be prepared in accordance with the requirements of Section 03300 entitled "Cast-in-Place Concrete."

- E. Adequate means shall be provided for anchoring the waterstop in concrete. Waterstops shall be positioned so that they are equally embedded in the concrete on each side of the joint.
- F. Sealant application shall be in accordance with the manufacturer's printed instructions. The surfaces of the groove for the sealant shall not be coated. Concrete next to waterstops shall be placed in accordance with the requirements of Section 03300 entitled, "Cast-in-Place Concrete."
- G. The primer and sealant shall be placed strictly in accordance with the printed recommendations of the manufacturer, taking special care to properly mix the sealant prior to application. All sealant shall cure at least 7 days before the structure is filled with water.
- H. All sealant shall be installed by a competent waterproofing specialty CONTRACTOR who has a successful record of performance in similar installations. Before work is commenced, the crew doing the Work shall be instructed as to the proper method of application by a representative of the sealant manufacturer.
- I. Thorough, uniform mixing of 2-part, catalyst-cured materials is essential; special care shall be taken to properly mix the sealer before its application. Before any sealer is placed, the CONTRACTOR shall arrange to have the crew doing the Work carefully instructed as to the proper method of mixing and application by a representative of the sealant manufacturer.
- J. Any joint sealant which, after the manufacturer's recommended curing time for the job conditions of the Work hereunder, fails to fully and properly cure shall be completely removed; the groove shall be thoroughly sandblasted to remove all traces of the uncured or partially cured sealant and primer, and shall be re-sealed with the specified joint sealant. All costs of such removal, joint treatment, re-sealing, and appurtenant work shall be at the expense of the CONTRACTOR.

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 contraction joints in concrete, except where Type 7 or Type 8 is required as stated below, and wherever else specified or shown on the Drawings. It 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.

- END OF SECTION -

SECTION 03300 - CAST-IN-PLACE CONCRETE

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The CONTRACTOR shall furnish all materials for concrete in accordance with the provisions of this Section and shall form, mix, place, cure, repair, finish, and do all other work as required to produce finished concrete, all in accordance with the requirements of the Contract Documents.
- B. The requirements in this section shall apply to the following types of concrete:
 - 1. Class A1 Concrete: Normal weight structural concrete to be used in all structures qualifying as environmental concrete structures that are designed in accordance with ACI 350 including pump stations, tanks, basins, process structures, and any structures containing fluids or process chemicals or other materials used in treatment process.
 - 2. Class A2 Concrete: Normal weight structural concrete to be used in walls of structures qualifying as environmental concrete structures as described above. Class A2 concrete is similar to Class A1 except that Class A2 shall contain a mandatory addition of high range water reducer.
 - 3. Class A3 Concrete: Normal weight structural concrete in all structures other than structures qualifying as environmental concrete structures as described above.
 - 4. Class B Concrete: Normal weight structural concrete with pea-rock aggregate. Class B concrete shall be used only at locations indicated on the Drawings or approved on a case by case basis by the Engineer.
 - 5. Class C Concrete: Normal weight structural concrete used in duct bank encasements, catch basins, fence and guard post embedment, concrete fill, sidewalks, and other areas where specifically noted on the Contract Drawings.
 - 6. Flowable Fill: Lean concrete proportioned without the use of coarse aggregate primarily for use as pipe backfill. Flowable fill shall be utilized only at locations indicated on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 01300 - Submittals
- B. Section 01400 – Testing and Inspection
- C. Section 03100 - Concrete Formwork
- D. Section 03200 - Concrete Reinforcement
- E. Section 03315 - Grout

F. Section 05500 - Metal Fabrications

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 or exceed the requirements of the Florida Building Code (FBC) and 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.

B. Codes and Standards

1. The Building Code, as referenced herein, shall be the Florida Building Code.

C. Federal Specifications

1. UU-B-790A (Int.Amd. 1) Building Paper, Vegetable Fiber (Kraft, Waterproofed, Water Repellant and Fire Resistant).

D. Commercial Standards

1. ACI 214 Recommended Practice for Evaluation of Strength Test Results of Concrete.
2. ACI 301 Specifications for Structural Concrete for Buildings.
3. ACI 305 Hot Weather Concreting.
4. ACI 306 Cold Weather Concreting.
5. ACI 309 Recommended Practice for Consolidation of Concrete
6. ACI 315 Details and Detailing of Concrete Reinforcement.
7. ACI 318 Building Code Requirements for Reinforced Concrete.
8. ACI 347 Recommended Practice for Concrete Formwork.
9. ACI 350 Environmental Engineering Concrete Structures.
10. ASTM C 31 Methods of Making and Curing Concrete Test Specimens in the Field.
11. ASTM C 33 Specification for Concrete Aggregates.
12. ASTM C 39 Test Method for Compressive Strength of Cylindrical Concrete Specimens.
13. ASTM C 88 Test Method for Soundness of Aggregates by use of Sodium Sulfate or Magnesium Sulfate.

14. ASTM C 94 Specification for Ready-Mixed Concrete.
 15. ASTM C 114 Method for Chemical Analysis of Hydraulic Cement.
 16. ASTM C 136 Method for Sieve Analysis of Fine and Coarse Aggregate.
 17. ASTM C 143 Test Method for Slump of Portland Cement Concrete.
 18. ASTM C 150 Specification for Portland Cement.
 19. ASTM C 156 Test Method for Water Retention by concrete Curing Materials.
 20. ASTM C 157 Test Method for length Change of Hardened Cement Mortar and Concrete.
 21. ASTM C 192 Method of Making and Curing concrete Test Specimens in the Laboratory.
 22. ASTM C 227 Standard Test Method for Potential Alkali Reactivity of Cement Aggregate Combinations (Mortar-Bar Method).
 23. ASTM C 260 Specification for Air-Entraining Admixtures for Concrete.
 24. ASTM C 289 Standard Test Method for Potential Reactivity of Aggregates (Chemical Method).
 25. ASTM C 494 Specification for Chemical Admixtures For Concrete.
 26. ASTM C 586 Standard Test Method for Potential Alkali Reactivity of Carbonate Rocks for Concrete Aggregates (Rock Cylinder Method).
 27. ASTM C 618 Standard Specification for Fly Ash and Raw or Calcined Natural Pozzolan for use as a Mineral Admixture in Portland Cement Concrete.
 28. ASTM D 1751 Specification for preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types).
 29. ASTM D 6103 Standard Test Method for Flow Consistency of Controlled Low Strength Material
 30. ASTM E11 Specification for Wire-Cloth Sieves for Testing Purposes.
 31. ASTM E 119 Method for Fire Tests of Building Construction and Materials.
- E. Any procedure, materials or operation specified by reference to the American Society for Testing and Materials (ASTM), the American Concrete Institute (ACI), Building Code or other references shall comply with the requirements of the current and most recent specifications or standards. In conflicts between listed standards and this specification, the more stringent requirements shall govern.
- F. The Contractor is expected to obtain the most recent issue of all standards, recommendations, codes or specifications referred to within this specification.

1.04 SUBMITTALS

- A. The design mixes to be used shall be prepared by qualified persons and submitted for review. The design of the mix is the responsibility of the CONTRACTOR subject to the limitations of the specifications. Review processing of this submission will be required only as evidence the mix has been designed by qualified persons and that the minimum requirements of the specifications have been met. Such review will in no way alter the responsibility of the CONTRACTOR to furnish concrete meeting the requirements of the specifications. If in the progress of the work the sources of materials change in characteristics or the CONTRACTOR requests a new source in writing, the CONTRACTOR shall, at his expense submit new test data and information for the establishment of a new design mix. Submit mix designs for all classes of concrete to be used under this Contract. Mix design submittals shall include the following:
1. Sources of all materials and certifications of compliance with specifications for all sources of each material.
 2. Certified current (less than one year old) chemical analysis of Portland Cement or Blended Cement to be used.
 3. Certified current (less than one year old) chemical analysis of fly ash to be used.
 4. Manufacturer's data on all admixtures stating compliance with required standards and are compatible with one another. Written conformance to the above mentioned requirements and the chloride ion content of the admixture will be required from the admixture manufacturer prior to Mix design review by the ENGINEER.
 5. Field experience records and/or trial mix data for the proposed concrete mixes.
- B. Where ready-mix concrete is used, the CONTRACTOR shall provide delivery tickets at the time of delivery of each load of concrete. In addition to the information required by ASTM C94, each ticket shall show the mix number, cement content, water/cementitious ratio, and amount of water allowed to be added to truck without exceeding required water/cementitious ratio.
- C. A schedule of all concrete placement with volume of concrete planned to be placed each day.
- D. A layout of all structures with all planned construction joint locations.

1.05 QUALITY ASSURANCE

- A. Plant equipment and facilities shall meet all requirements of the Check List for Certification of Ready Mixed Concrete Production facilities of the National Ready Mixed Concrete Association and ASTM C 94.
- B. Tests for compressive strength and slump of concrete will be performed as specified herein. Test for determining slump will be in accordance with the requirements of ASTM C 143.

- C. The cost of initial trial mixes and initial laboratory tests to design the mixes including compression tests, sieve analysis, and tests on trial mixes shall be included in the Contract Price.
- D. The cost of all tests during construction will be borne by the CITY. However, the CONTRACTOR shall be charged for the cost of any additional tests and investigation on work performed which does not meet the Specifications. All test results shall be sent directly to the ENGINEER. The CONTRACTOR shall be responsible for coordination of all tests with the testing laboratory.
- E. Concrete for testing shall be supplied by the CONTRACTOR at no cost to the CITY, and the CONTRACTOR shall provide assistance to the ENGINEER in obtaining samples. The CONTRACTOR shall dispose of and clean up all excess material.
- F. Construction Tolerances
 - 1. The CONTRACTOR shall set and maintain concrete forms and perform finishing operations so as to ensure that the completed work is within the tolerances specified herein. Surface defects and irregularities are defined as finishes and are to be distinguished from tolerances. Tolerance is the specified permissible variation from lines, grades, or dimensions shown. Where tolerances are not stated in the Specifications, permissible deviations will be in accordance with ACI 347 and Section 03100 entitled "Concrete Formwork".

1.06 QUALITY CONTROL

A. Compressive Strength

- 1. Compression test specimens shall be taken during construction from the first placement of each class of concrete specified herein and at intervals thereafter as selected by the ENGINEER to insure continued compliance with these Specifications. At least one set of test specimens shall be made for each placement in excess of five cubic yards, or for each fifty (50) cubic yards of concrete placed, or for each 5000 square feet of surface area for slabs or walls, whichever is greater.
- 2. Samples of freshly mixed concrete shall be obtained in accordance with ASTM C 172, and compression test specimens for concrete shall be made in accordance with ASTM C 31. Specimens shall consist of at least five 6-inch diameter by 12-inch high cylinders, or eight 4-inch diameter by 8-inch high cylinders. Each cylinder shall be identified by a tag attached to the side of the cylinder.
- 3. 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 specimens 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 C31. Such box shall be located in an area free from vibration such as pile driving and traffic of all kinds. No concrete requiring inspection shall be delivered to the site until such storage curing box has been provided. Specimens

shall remain undisturbed in the curing box until ready for delivery to the testing laboratory but not less than sixteen hours

4. Compression test shall be performed in accordance with ASTM C 39. For 6x12 cylinders, two test cylinders will be tested at 7 days and 2 at 28 days. For 4x8 cylinders, three test cylinders will be tested at 7 days and three at 28 days. The remaining cylinders will be held to verify test results, if needed.

B. Consistency

1. Consistency of the concrete will be checked by the ENGINEER by standard slump cone tests. The CONTRACTOR shall make any necessary adjustments in the mix as the ENGINEER 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 delays, material or labor costs due to such eventualities.
2. Slump tests shall be made in accordance with ASTM C 143. Slump tests shall be performed as deemed necessary by the ENGINEER and each time compressive strength samples are taken.

C. Air Content

1. Samples of freshly mixed concrete will be tested for entrained air content by the ENGINEER in accordance with ASTM C 231.
2. Air content tests will be performed as deemed necessary by the ENGINEER and each time compressive strength samples are taken.

D. Evaluation and Acceptance of Concrete

1. Evaluation and acceptance of the compressive strength of concrete shall be according to the requirements of ACI 215 and ACI 318, Chapter 5 "Concrete Quality Mixing and Placing", and as specified herein.
2. If any concrete fails to meet these requirements, immediate corrective action shall be taken to increase the compressive strength for all subsequent batches of the type of concrete affected.
3. All concrete which fails to meet the ACI requirements and these specifications, is subject to removal and replacement at the cost of the CONTRACTOR. Additional testing may also be required to verify compressive strength of concrete. Additional testing shall involve extraction and testing of concrete cores in accordance with ASTM C 42. ENGINEER shall determine locations where concrete cores shall be taken. Nondestructive test methods shall not be used to verify strength of in-place concrete.

1.07 PRE-CONCRETE CONFERENCE

- A. At least 35 days prior to start of the Concrete construction schedule, the CONTRACTOR shall conduct a meeting to review the proposed mix designs and to discuss the required

methods and procedures to achieve the required concrete construction. The CONTRACTOR shall send a pre-concrete conference agenda to all attendees 20 days prior to the scheduled date of the conference.

- B. 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. For the concrete design mix – Laboratory retained for trial batching and tests
 - 3. For field quality control – Concrete subcontractor, Concrete producer, Admixture Manufacturer(s), Concrete pumping contractor
- C. Minutes of the meeting shall be recorded, typed and printed by the CONTRACTOR and distributed by him to all parties concerned within five days of the meeting. One copy of the minutes shall also be transmitted to the ENGINEER.
- D. The minutes shall include a statement by the admixture manufacturer(s) indicating that the proposed mix design and placing techniques can produce the concrete quality required by these Specifications.
- E. The ENGINEER will be present at the conference. The CONTRACTOR shall notify the ENGINEER at least 20 days prior to the scheduled date of the conference.

PART 2 --PRODUCTS

2.01 CONCRETE MATERIALS

- A. Materials shall be delivered, stored, and handled so as to prevent damage by water or breakage. Only one brand of cement shall be used. Cement reclaimed from cleaning bags or leaking containers shall not be used. All cement shall be used in the sequence of receipt of shipments.
- B. All materials furnished and stored for the work shall comply with the requirements of ACI 301, as applicable.
- C. Materials for concrete shall conform to the following requirements:
 - 1. Cement shall be standard brand Portland cement conforming to ASTM C 150 for Type II. Portland cement shall contain not more than 0.60 percent alkalis. The term "alkalis" referred to herein is defined as the sum of the percentage of sodium oxide and 0.658 times the percentage of potassium oxide ($\text{Na}_2\text{O} + 0.658 \text{ K}_2\text{O}$). These oxides shall be determined in accordance with ASTM C 114. A single brand of cement shall be used throughout the Work, and prior to its use, the brand shall be acceptable to the ENGINEER. The cement shall be suitably protected from exposure to moisture until used. Cement that has become lumpy shall not be used. Sacked cement shall be stored in such a manner so as to permit access for inspection and sampling. Certified mill test reports for each shipment of cement to be used shall be

submitted to the ENGINEER if requested regarding compliance with these Specifications. The proposed Portland cement shall not contain more than 8% tricalcium aluminate and more than 12% tetracalcium aluminoferrite.

2. Fly ash shall meet the requirements of ASTM C 618 for Class F, except the loss on ignition shall not exceed 4%. The fly ash constituent shall be maximum 15% of the total weight of the combined Portland cement and fly ash. For concrete to be used in environmental concrete structures, i.e. process structures or fluid containing structures, inclusion of fly ash in concrete mix is mandatory.
3. Water shall be potable, clean, and free from objectionable quantities of silty organic matter, alkali, salts and other impurities. The water shall be considered potable, for the purposes of this Section only, if it meets the requirements of the local governmental agencies.
4. Aggregates shall be obtained from pits acceptable to the ENGINEER, shall be non-reactive, and shall conform to the FBC and ASTM C 33. Maximum size of coarse aggregate shall be as specified in Article 2.04, Paragraph B of this Section. Lightweight sand for fine aggregate will not be permitted.
 - a. CONTRACTOR shall submit a new trial mix to the ENGINEER for approval whenever a different aggregate or gradation is proposed.
 - b. Coarse aggregates shall consist of clean, hard, durable gravel, crushed gravel, crushed rock or a combination thereof. The coarse aggregates shall be prepared and handled in two or more size groups for combined aggregates with a maximum size not greater than 1 inch. When the aggregates are proportioned for each batch of concrete the two size groups shall be combined.
 - c. Fine aggregates shall be manufactured sand that is hard and durable.
 - d. Combined aggregates shall be well graded from coarse to fine sizes, and shall be uniformly graded between screen sizes to produce a concrete that has optimum workability and consolidation characteristics. Where a trial batch is required for a mix design, the final combined aggregate gradations will be established during the trial batch process.
 - e. When tested in accordance with "Organic Impurities in Sands for Concrete" (ASTM C 40), the fine aggregate shall produce a color in the supernatant liquid no darker than the reference standard color solution.
 - f. When tested in accordance with "Resistance to Abrasion of Small size Coarse Aggregate by Use of the Los Angeles Machine" (ASTM C 131), the coarse aggregate shall show a loss not exceeding 42 percent after 500 revolutions, or 10.5 percent after 100 revolutions.
 - g. When tested in accordance with "Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate" (ASTM C 88), the loss resulting after five cycles shall not exceed 10 percent for fine or coarse aggregate when using sodium sulfate.

2.02 ADMIXTURES

- A. Air-entraining agent meeting the requirements of ASTM C 260, shall be used. Sufficient air-entraining agent shall be used to provide a total air content of 3 to 5 percent. Air-entraining agent shall be Sika AER by Sika Corp., MB-VR by Master Builders, Darex AEA by Grace, AEA-92S by Euclid Chemical Company, or equal.
- B. Admixtures shall be required at the ENGINEER's discretion or, if not required, may be added at the CONTRACTOR's option to control the set, effect water reduction, and increase workability. In either case, the addition of an admixture shall be at the CONTRACTOR's expense. The use of an admixture shall be subject to acceptance by the ENGINEER. Concrete containing an admixture shall be first placed at a location determined by the ENGINEER. If the use of an admixture is producing an inferior end result, the CONTRACTOR shall discontinue use of the admixture. Admixtures specified herein shall conform to the requirements of ASTM C 494. The required quantity of cement shall be used in the mix regardless of whether or not an admixture is used. Admixtures shall contain no free chloride ions, be non-toxic after 30 days, and shall be compatible with and made by the same manufacturer as the air entraining admixture.
 - 1. Set controlling admixture shall be either with or without water-reducing properties. Where the air temperature at the time of placement is expected to be consistently over 80 degrees Fahrenheit, a set retarding admixture such as Sika Chemical Corporation's Plastiment, Pozzoloth 200N by BASF, or equal shall be used. Where the air temperature at the time of placement is expected to be consistently under 40 degrees Fahrenheit, a non-chloride, non-corrosive set accelerating admixture such as Sika Chemical Corporation's Plastocrete 161FL, Pozzoloth NC534 by BASF, or equal shall be used.
 - 2. Low range water reducer shall be added to all structural concrete, and shall conform to ASTM C 494, Type A. It shall be either a hydroxylated carboxylic acid type or a dydroxylated polymer type. The quantity of admixture used and the method of mixing shall be in accordance with the manufacturer's instructions and recommendations.
 - 3. Water reducing and retarding admixture shall be in conformance with ASTM C 494 Type D free of chlorides, "Pozzoloth 200N" by BASF, "WRDA-64" by Grace or equal.
 - 4. High range water reducer shall be sulfonated polymer conforming to ASTM C 494, Type F or G. 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, "Rheobuild 1000 or Glenium Series" by BASF, and "Daracem 100 or Advaflo Series" by W.R. Grace.
 - 5. The CONTRACTOR shall submit certification from each admixture manufacturer that all admixtures utilized in the design mix are compatible with one another and properly proportioned.

6. Prohibited Admixtures: Calcium chloride, thiocyanate or admixtures containing more than 0.05 percent chloride ions are not permitted.

2.03 ACCESSORIES

- A. Epoxy adhesives shall be the following products for the applications specified to be used in strict accordance with manufacturer's recommendations.
1. For bonding freshly-mixed, plastic concrete to hardened concrete, Sikadur 32 Hi-Mod, LPL Epoxy Adhesive, as manufactured by Sika Chemical Corporation; Concrecive 1001-LPL, as manufactured by Adhesive Engineering Company; or equal.
 2. For bonding hardened concrete or masonry to steel, Colma-Dur Gel, Sikadur Hi-Mod Gel, or equal.

2.04 CONCRETE MIX

- A. Concrete shall be composed of cement, admixtures, aggregates and water. These materials shall be of the qualities specified. The exact proportions in which these materials shall be based on the results of field experience or laboratory trial mixes in conformance with Section 5.3 "Proportioning on the Basis of Field Experience and/or Laboratory Trial Mixtures" of ACI 318. In general, the mix shall be designed to produce a concrete capable of being deposited so as to obtain maximum density and minimum shrinkage and, where deposited in forms, to have good consolidation properties and maximum smoothness of surface. Mix designs with more than 41 percent of sand of the total weight of fine and coarse aggregate shall not be used for Class A1 and A2 Concrete. The aggregate gradations shall be formulated to provide fresh concrete that will not promote rock pockets around reinforcing steel or embedded items. The proportions shall be changed whenever necessary or desirable to meet the required results at no additional cost to the CITY. All changes shall be subject to review by the ENGINEER.
- B. The proportions of cement, aggregates, admixtures and water used in the concrete shall be based on tests of grading and moisture content of materials, slump of concrete mixture, strength of concrete and the following factors:
1. Class A1 Concrete: Normal weight structural concrete to be used in all structures qualifying as environmental concrete structures that are designed in accordance with ACI 350 including pump stations, tanks, basins, process structures, and any structures containing fluids or process chemicals or other materials used in treatment process

Minimum cementitious materials 611 lbs.
content, per cubic yard

Water-cementitious materials ratio, Maximum 0.42
by weight Minimum 0.39

Slump range	3 inches to 4 inches with water reducing admixture
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Coarse Aggregate	#57 per ASTM C33
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Compressive strength at 28 days – F'c	4,500 psi
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Air Content	3% \pm 1%
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2. Class A2 Concrete: Normal weight structural concrete to be used in walls of structures qualifying as environmental concrete structures as described above. Class A2 concrete is similar to Class A1 except that Class A2 shall contain a mandatory addition of high range water reducer.

Minimum cementitious materials content, per cubic yard	611 lbs.
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Water-cementitious materials ratio, by weight	Maximum 0.42 Minimum 0.39
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Slump range	3 inches maximum before addition of high range water reducing admixture 8 inches maximum after addition of high range water reducing admixture
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Coarse Aggregate	#57 per ASTM C33
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Compressive strength at 28 days – F'c	4,500 psi
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Air Content	3% \pm 1%
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3. Class A3 Concrete: Normal weight structural concrete in all structures other than structures qualifying as environmental concrete structures as described above.

Minimum cementitious materials content, per cubic yard	611 lbs.
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Water-cementitious materials ratio, by weight	Maximum 0.45 Minimum 0.39
---	------------------------------

Slump range	3 inches to 4 inches with water reducing admixture
-------------	--

Compressive strength at 28 days - F'c	4,000 psi
---------------------------------------	-----------

Coarse Aggregate	#57 per ASTM C33
------------------	------------------

- | | |
|-------------|-------------|
| Air Content | 3% \pm 1% |
|-------------|-------------|
4. Class B Concrete: Normal weight structural concrete with pea-rock aggregate. Class B concrete shall be used only at locations indicated on the Drawings or approved on a case by case basis by the Engineer.
- | | |
|--|------------------------------|
| Minimum cementitious materials content, per cubic yard | 517 lbs. |
| Water-cementitious materials ratio, by weight | Maximum 0.50
Minimum 0.39 |
| Slump, maximum | 5 inches |
| Compressive strength at 28 days - F'c | 4,000 psi |
| Coarse Aggregate | Pearock |
| Air Content | 3% \pm 1% |
5. Class C Concrete: Normal weight structural concrete used in duct bank encasements, catch basins, fence and guard post embedment, concrete fill, sidewalks, and other areas where specifically noted on the Contract Drawings
- | | |
|--|------------------|
| Minimum cementitious materials content, per cubic yard | 500 lbs. |
| Water-cementitious materials ratio, by weight | Maximum 0.60 |
| Slump, maximum | 5 inches |
| Compressive strength at 28 days - F'c | 3,000 psi |
| Coarse Aggregate | #57 per ASTM C33 |
| Air Content | 3% \pm 1% |
6. Flowable Fill (In lieu of pipe bedding, select backfill)
- | | |
|--|-------------|
| Minimum cementitious materials content, per cubic yard | 100 lbs. |
| Water-cementitious materials ratio, by weight | Maximum 5.0 |
| Flowability, minimum | 8 inches |
| Compressive strength at 28 days - F'c | 50-150 psi |

Coarse aggregate

none

Fine aggregate

limestone screenings

- C. All Class A1, A2, A3 concrete, unless noted otherwise on the Drawings, shall be air entrained concrete. A water reducing admixture may be added to the mix at the CONTRACTOR's option.
- D. The mix proportions used shall be changed subject to the limitation specified herein, whenever such change is necessary or desirable to secure the required strength, density, workability, and surface finish and the CONTRACTOR shall be entitled to no additional compensation because of such changes.

2.05 CONSISTENCY

- A. The quantity of water entering into a batch of concrete shall be just sufficient, with a normal mixing period, to produce a concrete which can be worked properly into place without segregation, and which can be compacted by the vibratory methods herein specified to give the desired density, impermeability and smoothness of surface. The quantity of water shall be changed as necessary, with variations in the nature or moisture content of the aggregates, to maintain uniform production of a desired consistency. The consistency of the concrete in successive batches shall be determined by slump tests in accordance with ASTM C 143.

2.06 READY-MIXED CONCRETE

- A. Ready-mixed concrete shall be used meeting the requirements as to materials, batching, mixing, transporting, and placing as specified herein and in accordance with ASTM C 94.
- B. Ready-mixed concrete shall be delivered to the site of the work, and discharge shall be completed within one and one-half hour after the addition of the cement to the aggregates or before the drum has been revolved 250 revolutions, whichever is first. Upon delivery from the truck concrete temperature shall not exceed 90 degrees Fahrenheit.
- C. 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. The counters shall be actuated at the time of starting mixers at mixing speeds.
- D. Each batch of concrete shall be mixed in a truck mixer for not less than 70 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 revolution of mixing.

PART 3 -- EXECUTION

3.01 PROPORTIONING AND MIXING

- A. Proportioning of the concrete mix shall be based on the results of field experience or laboratory trial mixes in conformance with Section 5.3, "Proportioning on the Basis of Field Experience and/of Trial Mixtures" of ACI 318. When trial mixes are used they shall conform to the requirements of Chapter 3 "Proportioning" of ACI 301; provided, that the maximum slump for any concrete shall not exceed the limits specified in this Section of the Specifications.
- B. When field experience records are inadequate to confirm the quality of a proposed concrete mix in accordance with Section 5.3, "Proportioning on the Basis of Field Experience and/or Trial Mixtures" of ACI 318, or when required by the ENGINEER, an independent testing laboratory designated by the CONTRACTOR and acceptable to the ENGINEER 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 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 PART 2 -- 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 CITY.
- C. An independent testing laboratory shall observe the preparation of the trial batch, and they 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 unit weight (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. _____, Product _____." 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 CITY. Adjustments to the mix shall be considered refinements to the mix design and shall not be the basis for extra compensation to the CONTRACTOR.
- D. Mixing of concrete shall conform to the requirements of Chapter 4 of ACI 301 Specifications.
- E. Retempering of concrete or mortar which has partially hardened will not be permitted.

3.02 PREPARATION

- A. Earth surfaces shall be thoroughly wetted by sprinkling, prior to the placing of any concrete, and these surfaces shall be kept moist by frequent sprinkling up to the time of placing concrete thereon. A vapor barrier specified in Section 07190 entitled "Vapor Barrier" shall be placed. The surface shall be free from standing water, mud, and debris at the time of placing concrete.
- B. No concrete shall be placed until the reinforcement steel and formwork have been erected in a manner acceptable to the ENGINEER. The CONTRACTOR shall notify the ENGINEER

not less than two working days prior to Concrete Placement, allowing one day for review and any corrective measures which are required.

C. Joints in Concrete

1. Concrete surfaces upon or against which concrete is to be placed shall be given a roughened surface for good bond and a bonding agent shall be placed.
2. After the surfaces have been prepared all approximately horizontal construction joints shall be covered with a layer of mortar approximately one-inch thick. The mortar shall have the same proportions of cement and sand as the regular concrete mixture. The water-cement ratio of the mortar in place shall not exceed that of the concrete to be placed upon it, and the consistency of the mortar shall be suitable for placing and working in the manner hereinafter specified. The mortar shall be spread uniformly and shall be worked thoroughly into all irregularities of the surface. Wire brooms shall be used where possible to scrub the mortar into the surface. Concrete shall be placed immediately upon the fresh mortar.

D. Placing Interruptions

1. When placing of concrete is to be interrupted long enough for the concrete to take a set, the working face shall be given a shape by the use of forms or other means, that will secure proper union with subsequent work; provided that construction joints shall be made only where acceptable to the ENGINEER. Cold joints will be sufficient cause for rejection of the work.

E. Embedded Items

1. No concrete shall be placed until all formwork, installation of parts to be embedded, reinforcing steel, and preparation of surfaces involved in the placing have been completed and accepted by the ENGINEER at least four hours before placement of concrete. All surfaces of forms and embedded items that have become encrusted with dried grout from concrete previously placed shall be cleaned of all such grout before the surrounding or adjacent concrete is placed.
2. All inserts or other embedded items shall conform to the requirements herein.

F. All reinforcement, anchor bolts, sleeves, inserts, and similar items shall be set and secured in the forms where shown on the Drawings or by shop drawings and shall be acceptable to the ENGINEER before any concrete is placed. Accuracy of placement is the responsibility of the CONTRACTOR.

G. All anchor bolts called for on the drawings shall be cast-in-place in the concrete. Drilled, impact, adhesive or other types of anchors shall not be substituted for anchor bolts unless otherwise shown on the Drawings. Anchor bolts shall conform to the requirements set forth in Section 05050 entitled "Metal Fastening".

H. Casting New Concrete Against Old

1. Where concrete is to be cast against old concrete (any concrete which is greater than 60 days of age), the surface of the old concrete shall be thoroughly cleaned and

roughened by sand-blasting (exposing aggregate) prior to the application of an epoxy bonding agent.

- I. No concrete shall be placed in any structure until all water entering the space to be filled with concrete has been properly cut off or has been diverted by pipes, or other means, and carried out of the forms, clear of the work. No concrete shall be deposited underwater, except where shown on the Drawings to be placed by the tremie method, nor shall the CONTRACTOR allow still water to rise on any concrete until the concrete has attained its initial set. Water shall not be permitted to flow over the surface of any concrete in such manner and at such velocity as will injure the surface finish of the concrete. Pumping or other necessary dewatering operations for removing ground water, if required, will be subject to the review of the ENGINEER.
- J. Corrosion Protection
 - 1. Pipe, conduit, dowels, and other ferrous items required to be embedded in concrete construction shall be so positioned and supported prior to placement of concrete that there will be a minimum of 2 inches clearance between said items and any part of the concrete reinforcement. Securing such items in position by wiring or welding them to the reinforcement will not be permitted.
 - 2. Openings for pipes, inserts for pipe hangers and brackets, and the setting of anchors shall, where practicable, be provided for during the placing of concrete.
 - 3. Anchor bolts shall be accurately set, and shall be maintained in position by templates while being embedded in concrete.
 - 4. The surfaces of all 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.

3.03 PLACING CONCRETE

- A. Placing of concrete shall conform to the applicable requirements of Chapter 8 of ACI 301 and the requirements of this Section.
- B. Non-Conforming Work or Materials
 - 1. Concrete which upon or before placing is found not to conform to the requirements specified herein shall be rejected and immediately removed from the Work. Concrete which is not placed in accordance with these Specifications, or which is of inferior quality, shall be removed and replaced by and at the expense of the CONTRACTOR.
- C. Unauthorized Placement
 - 1. No concrete shall be placed except in the presence of duly authorized representative of the ENGINEER. The CONTRACTOR shall notify the ENGINEER at least 24 hours in advance of placement of any concrete.
- D. Placement in Wall Forms

1. Concrete shall not be dropped through reinforcement steel or into any deep form, whether reinforcement is present or not, causing separation of the coarse aggregate from the mortar on account of repeatedly hitting rods or the sides of the form as it falls, nor shall concrete be placed in any form in such a manner as to leave accumulation of mortar on the form surfaces above the placed concrete. In such cases, some means such as the use of hoppers and, if necessary, vertical ducts of canvas, rubber, or metal shall be used for placing concrete in the forms in a manner that it may reach the place of final deposit without separation. In no case shall the free fall of concrete exceed 4 feet below the ends of ducts, chutes, or buggies.
2. Concrete shall be uniformly distributed during the process of depositing and in no case after depositing shall any portion be displaced in the forms more than 6 feet in horizontal direction. Concrete in forms shall be deposited in uniform horizontal layers not deeper than 2 feet; and care shall be taken to avoid inclined layers or inclined construction joints except where such are required for sloping members. Each layer shall be placed while the previous layer is still soft. The rate of placing concrete in forms shall not exceed 5 feet of vertical rise per hour.

E. Casting New Concrete Against Old

1. An epoxy adhesive bonding agent shall be applied to set surfaces of construction joints according to the manufacturer's written recommendations.

F. Conveyor Belts and Chutes

1. All ends of chutes, hopper gates, and all other points of concrete discharge throughout the CONTRACTOR's conveying, hoisting and placing system shall be so designed and arranged that concrete passing from them will not fall separated into whatever receptacle immediately receives it. Conveyor belts, if used, shall be of a type acceptable to the ENGINEER. Chutes longer than 50 feet will not be permitted. Minimum slopes of chutes shall be such that concrete of the specified consistency will readily flow in them. If a conveyor belt is used, it shall be wiped clean by a device operated in such a manner that none of the mortar adhering to the belt will be wasted. All conveyor belts and chutes shall be covered. Sufficient illumination shall be provided in the interior of all forms so that the concrete at the places of deposit is visible from the deck or runway.

G. Placement in Slabs

1. Concrete placed in sloping slabs shall proceed uniformly from the bottom of the slab to the top, for the full width of the pour. As the work progresses, the concrete shall be vibrated and carefully worked around the slab reinforcement, and the surface of the slab shall be screeded in an up-slope direction.

H. Temperature of Concrete

1. The temperature of concrete when it is being placed shall be not more than 90 degrees F. Concrete ingredients shall not be heated to a temperature higher than that necessary to keep the temperature of the mixed concrete, as placed, from falling below the specified minimum temperature. If concrete is placed when the weather is such that the temperature of the concrete would exceed 90 degrees Fahrenheit, the

CONTRACTOR shall employ effective means, such as precooling of aggregates and mixing water using ice or placing at night, as necessary to maintain the temperature of the concrete, as it is placed, below 90 degrees F. The CONTRACTOR shall be entitled to no additional compensation on account of the foregoing requirements. During summer months concrete pours shall be scheduled in the morning or early part of the day when temperatures are cooler.

I. Pumping Equipment

1. Pumping equipment and procedures if used shall conform to the recommendations contained in the report of ACI Committee 304 on Placing Concrete by Pumping Methods, ACI 304.2R. The specified slump shall be measured at the point of discharge. The loss of slump in pumping shall not exceed 1-1/2 inches.
- J. The order of placing concrete in all parts of the work shall be acceptable to the ENGINEER. In order to minimize the effects of shrinkage, the concrete shall be placed in units as bounded by construction joints shown on the Drawings. The placing of units shall be done by placing alternate units in a manner such that each unit placed shall have cured at least 7 days before the contiguous unit or units are placed, except that the corner sections of vertical walls shall not be placed until the 2 adjacent wall panels have cured at least 14 days.
- K. The surface of the concrete shall be level whenever a run of concrete is stopped. To ensure a level, straight joint on the exposed surface of walls, a wood strip at least 3/4-inch thick shall be tacked to the forms on these surfaces. The concrete shall be carried about 1/2-inch above the underside of the strip. About one hour after the concrete is placed, the strip shall be removed and any irregularities in the edge formed by the strip shall be leveled with a trowel and all laitance shall be removed.
- L. As concrete is placed in the forms or in excavations, it shall be thoroughly settled and compacted, throughout the entire depth of the layer which is being consolidated, into a dense, homogeneous mass, filling all corners and angles, thoroughly embedding the reinforcement, eliminating rock pockets, and bringing only a slight excess of water to the exposed surface of concrete during placement. Vibrators shall be high speed power vibrators (8000 to 10,000 rpm) of an immersion type in sufficient number and with (at least one) standby units as required.
- M. Care shall be used in placing concrete around waterstops. The concrete shall be carefully worked by rodding and vibrating to make sure that all air and rock pockets have been eliminated. Where flat-strip type waterstops are placed horizontally, the concrete shall be worked under the waterstops by hand, making sure that all air and rock pockets have been eliminated. Concrete surrounding the waterstops shall be given additional vibration, over and above that used for adjacent concrete placement to assure complete embedment of the waterstops in the concrete.
- N. Concrete in walls shall be internally vibrated and at the same time, stirred, or worked with suitable appliances, tamping bars, shovels, or forked tools until it completely fills the forms or excavations and closes snugly against all surfaces. Subsequent layers of concrete shall not be placed until the layers previously placed have been worked thoroughly as specified. Vibrators shall be provided in sufficient numbers, with standby units as required, to accomplish the results herein specified within 15 minutes after concrete of the prescribed

consistency is placed in the forms. The vibrating head shall be kept from contact with the surfaces of the forms. Care shall be taken not to vibrate concrete excessively or to work it in any manner that causes segregation of its constituents.

3.04 CONCRETE FINISHING

- A. Concrete finishes are specified in Section 03350 entitled "Concrete Finishes".

3.05 CURING AND PROTECTION

- A. Curing is specified in Section 03370 entitled "Concrete Curing".

3.06 PLACING CONCRETE UNDERWATER (TREMIE CONCRETE)

- A. Placing concrete underwater will be permitted only when shown on the Drawings. Concrete deposited under water shall be carefully placed in a compacted mass in final position by means of a tremie, a closed bottom dump bucket or other approved method. Care must be exercised to maintain still water at the point of deposit. Concrete shall not be placed in running water. The consistency of the concrete shall be regulated to prevent segregation of materials. The method of depositing concrete shall be regulated such that the concrete enters the mass of the previously place concrete from within, displacing water with a minimum disturbance to the surface of the concrete.
- B. Tremie shall consist of a tube having a diameter of not less than 10 inches and constructed in sections having flanged couplings fitted with gaskets. The tremie shall be supported to permit free movement of the discharge and over the entire top surface of the work and shall permit rapid lowering when necessary to choke off or retard the flow. The discharge end shall be entirely sealed at all times and the tremie tube kept full to the bottom of the hopper. When a batch is dumped into the hopper, the tremie shall be slightly raised, but not out of the concrete at the bottom, until the batch discharges to the bottom of the hopper. The flow shall then be stopped by lowering the tremie. The flow shall be continuous until the placement has been completed.

3.07 PLACING CONCRETE UNDER PRESSURE (PUMPING)

- 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 be such that a continuous stream of concrete without air pockets is produced. To obtain the least line resistance, the layout of the pipeline system shall contain a minimum number of 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, if it is to be used, shall be ejected in such a manner that there will be no contamination of the concrete or separation of the ingredients.
- B. No aluminum parts shall be in contact with the concrete during the entire placing of concrete under pressure at any time.
- C. Prior to placing concrete under pressure, the CONTRACTOR shall submit the concrete mix design together with test results from a recognized testing laboratory proving the proposed mix meets all requirements. In addition, at the CONTRACTOR's option, an actual pumping test under field conditions may be performed prior to use of the accepted 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; the same pump and operator shall be present and the pipe and pipe layouts will reflect the maximum height and distance contemplated.

- D. 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.
- E. 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.
- F. The minimum diameter of the hose (conduits) shall be four inches.
- G. Pumping equipment and hoses (conduits) that are not functioning properly shall be replaced.

3.08 ORDER OF PLACING CONCRETE

- A. In order 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. The placing of units shall be done by placing alternate units in a manner such that each unit placed shall be have cured at least seven days before the contiguous unit or units are placed, except that the corner sections of vertical walls shall not be placed until the two adjacent wall panels have cured at least 14 days.
- B. The surface of the concrete shall be level whenever a run of concrete is stopped.

3.09 CONCRETE IN COLD WEATHER

- A. Cold weather concreting procedures shall be in accordance with the requirements of ACI 306

3.10 CONCRETE IN HOT WEATHER

- A. Hot weather concreting procedures shall conform to the requirement of ACI 305.

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. Particular care shall be taken to prevent the drying of concrete and to avoid roughening or otherwise damaging the surface. 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 the Contractor's expense.

- B. As soon as forms are removed, all exposed surfaces shall be carefully examined and Contractor shall immediately notify the Engineer. Plastering or coating of surfaces to be smoothed will not be permitted. No repairs shall be made until reviewed by the Engineer. In no case will extensive patching of honeycombed concrete be permitted.
- C. Concrete containing minor voids, holes, honeycombing, or similar depression defects shall have them repaired as directed. Concrete containing extensive voids, holes, honeycombing, or similar depression defects, shall be completely removed and replaced. All repairs and replacements herein specified shall be promptly executed by the Contractor at its own expense.
- D. Holes left by tie-rod cones shall be repaired in an acceptable manner with dry-packed cement grout or premixed patching material as accepted by the Engineer.
- E. 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.
- F. Concrete which fails to meet the strength requirements as outlined in Article 2.04, paragraph B, will be analyzed as to its adequacy based upon loading conditions, resultant stresses and exposure conditions for the particular 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.

3.12 CONCRETE SEALER

- A. Contractor shall apply a sealer to the top surface of all finished concrete floor slabs and equipment pads which are to remain unpainted and not intended to be immersed unless stated otherwise. Sealer shall be as specified in Specification Section 03350 entitled "Concrete Finishes".

- END OF SECTION -

SECTION 03315 - GROUT

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The CONTRACTOR shall furnish all materials for grout in accordance with the provisions of this Section and shall form, mix place, cure, repair, finish, and do all other Work as required to produce finished grout, all in accordance with the requirements of the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 01300 - Submittals
- B. Section 03300 - Cast-in-Place Concrete

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Specifications, codes, and standards shall be as specified in Section 03300 entitled "Cast-in-Place Concrete," and as referred to herein.
- B. Additional Commercial Standards

CRD-C 621 Corps of Engineers Specification for Nonshrink Grout

1.04 SUBMITTALS

- A. The CONTRACTOR shall submit certified test results verifying the compressive strength, shrinkage, and expansion requirements specified herein; and manufacturer's literature containing instructions and recommendations on the mixing, handling, placement and appropriate uses for each type of grout used in the work.

PART 2 -- PRODUCTS

2.01 PREPACKAGED NON-SHRINK CEMENTITIOUS GROUT

- A. Nonshrink grout shall be a prepackaged, inorganic, non-gas liberating, nonmetallic, cement-based grout requiring only the addition of water. Manufacturer's instructions shall be printed on each bag or other container in which the materials are packaged. The specific formulation for each class of nonshrink grout specified herein shall be that recommended by the manufacturer for the particular application.
- B. Nonshrink grouts shall have a minimum 28 day compressive strength of 5000 psi (ASTM C109, restrained), shall have no shrinkage (0.0 percent) and a maximum 4.0 percent expansion in the plastic state when tested in accordance with ASTM C 827, and shall have no shrinkage (0.0 percent) and a maximum of 0.2 percent expansion in the hardened state when tested in accordance with CRD C 621.

- C. Cement based grout shall be Five Star Grout as manufactured by Five Star Products, Inc., Fairfield, Connecticut, or equal.
- D. Cementitious non-shrink grout shall be used at locations where there are no dynamic loads, the grout will not come in contact with wastewater or wastewater gases, and where non-shrink grout is identified on the Drawings. Applications include, but are not limited to, structural steel column base plates, gate frames and guides, and precast concrete to cast-in-place concrete joints.

2.02 PREPACKAGED NON-SHRINK EPOXY GROUT

- A. Epoxy-based non-shrink grout shall be a three component, 100 percent solids, solvent-free system designed for machinery grouting. Applications include, but are not limited to, anchoring, pump and motor bases, and any other equipment imparting dynamic loads to the support system.
- B. When non-shrink grout is identified on the Drawings in submerged (water or wastewater) or under wastewater gas environment, epoxy-based non-shrink grouts shall be used.
- C. The epoxy grout shall be delivered to site as prepackaged, three-component systems composing of the resin, hardener, and specially blended aggregates. The components shall be stored as recommended by the manufacturer until use.
- D. Non-shrink epoxy grout shall be Five Star DP Epoxy Grout by Five Star Products, Inc., Fairfield, Connecticut, or equal.

2.03 CEMENT GROUT

- A. Cement grout shall be composed of portland cement 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 portland cement as required to match color of adjacent concrete.
- B. The minimum compressive strength at 28 days shall be 4000 psi.
- C. 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.
- D. Sand shall conform to the requirements of ASTM C144.

2.04 DOWEL/ANCHOR BOLT ADHESIVE SYSTEM

- A. When rebar or anchor bolts are specified to be drilled in and grouted on the Drawings, an adhesive system specified in Section 03200 entitled "Concrete Reinforcement" shall be used for dowels and an adhesive system specified in Section 05050 entitled "Metal Fastening" shall be used for anchor bolts.

2.05 CURING MATERIALS

- A. Curing materials shall be as recommended by the manufacturer.

2.06 CONSISTENCY

- A. The consistency of grouts shall be that necessary to completely fill the space to be grouted for the particular application. Dry pack consistency is such that the grout is plastic and moldable but will not flow. Where "dry pack" is called for in the Contract Documents, it shall mean a grout of the above described consistency; the type of grout to be used shall be as specified herein for the particular application.

2.05 MEASUREMENT OF INGREDIENTS

- A. Prepackaged grouts shall have ingredients measured by means recommended by the manufacturer.

PART 3 -- EXECUTION

3.01 GENERAL

- A. All curing, and protection of cement grout shall be as specified in Section 03370 entitled "Concrete Curing" (Methods 1 and 2); or as recommended by manufacturer. The finish of the grout surface shall match that of the adjacent concrete.
- B. 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.

3.02 CONSOLIDATION

- A. Grout shall be placed in such a manner, for the consistency necessary for each application, so as to assure that the space to be grouted is completely filled.

3.03 CURING

- A. Pre-packaged grout shall be cured as recommended by the grout manufacturer. Cement grout shall be cured by application of mist for four (4) days.

- END OF SECTION -

SECTION 03350 - CONCRETE FINISHES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The CONTRACTOR shall 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 03100 - Concrete Formwork
- B. Section 03300 - Cast-in-Place Concrete
- C. Section 03315 – 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 Reinforced Concrete

1.04 SUBMITTALS

- A. Submit the following in accordance with Section 01300 entitled "Submittals".
 - 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 VOX by the Euclid Chemical Company, MasterKure CC 300 SB by BASF Master Builder 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 silicate 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 silicate. Acceptable products are Diamond Hard by the Euclid Chemical Company, Seal Hard by L&M Construction Chemicals and MasterKure HD 210 by BASF Master Builder Solutions.

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 3.05 of this Section entitled "Concrete Finish Schedule". Unless the finish schedule specifies otherwise, all surfaces shall receive at least a Type I finish. The ENGINEER shall be the sole judge of acceptability of all concrete finish work.
1. Type I - Rough: All fins, burrs and other projections left by the forms shall be removed. All holes left by removal of ends of ties, and all other holes, depressions, or voids shall be filled solid with cement grout after first being thoroughly wetted. Honeycombs shall be chipped back to solid concrete as directed, prior to patching with cement grout. Holes shall be filled with a small tool that will permit packing the hole solidly with cement grout. Cement grout shall consist of one part cement to three parts sand, 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 predampened, a slurry consisting of one part cement (including an appropriate quantity of white cement in order 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. Any surplus shall be removed by scraping and then rubbing with clean burlap. The finish shall be kept damp for at least 36 hours after application.
 3. Type III - Smooth Rubbed: Where this finish is required, it shall be applied after the completion of the Type I 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 it with a carborundum stone to eliminate irregularities. Unless the nature of the irregularities require it, the general surface of the concrete shall not be cut into. Corners and edges shall be slightly rounded by the use of the carborundum stone. Brush finishing or painting with grout or neat cement will not be permitted.

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 of this Section entitled "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 stiff brush or rake prior to final set.
 2. Type "B" - Wood Floated: This finish shall be obtained after completion of a Type "A" finish by working a previously screeded surface with a wood float 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. The finished surface shall be true, even, and free from blemishes and other irregularities.

3. Type "C" - Cork Floated: This finish shall be similar to Type "B" but slightly smoother than that obtained with a wood float. It shall be obtained by power or hand 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, only one troweling operation is required. 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.
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, in accordance with Section 03315 – Grout, shall then 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.
7. Type "G" - Hardened Finish: Either a liquid hardened finish or an aggregate hardened finish shall be provided at the CONTRACTOR's option.
 - a. Liquid hardened finish shall be provided by application of a liquid floor hardener. Floors to receive this finish shall have previously received a Type "D" finish. Liquid hardener shall be applied between 30 to 60 days after concrete placement. Surface to be treated shall be dry, clean and free of all loose dust, dirt, oil, wax, sealers and curing compounds. Application procedure shall be in accordance with manufacturer's instructions and shall consist of a three-coat treatment.
 - b. Aggregate hardened finish shall be provided by applying an aggregate floor hardener concurrently with the application of a Type "D" finish. Application procedure shall be in accordance with manufacturer's instructions.
8. Type "H" - Non-Slip Finish: This finish shall be provided by applying a non-slip shake-on aggregate concurrently with the application of a Type "D" finish. Application procedure shall be in accordance with manufacturer's instructions.
9. 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.
- 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 non-shrink grout and support equipment bases, shall receive a Type "D" finish, unless otherwise noted. Surfaces which will later receive non-shrink 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 CONCRETE FINISH SCHEDULE

Item	Type of Finish
Concrete surfaces indicated to receive textured coating or special coating (as noted in Section 03732, Concrete Repairs)	I
Inner face of walls of tanks, flow channels, wet wells, perimeter walls, and miscellaneous concrete structures to be coated in accordance with Section 09900:	II*
Exterior concrete walls below grade	I
Exterior exposed concrete walls, ceilings, beams, manholes, handholes, 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 in buildings	III
Interior exposed ceiling, including beams	III
Floors of process equipment tanks or basins, and slabs to receive roofing material or waterproof membranes	B

Item	Type of Finish
All interior finish floors of buildings and structures and walking surfaces which will be continuously or intermittently wet	C
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
Concrete floors in flow channels	D
Exterior concrete sidewalks, steps, ramps, decks, slabs on grade and landings exposed to weather	E
Floors of process equipment tanks indicated on Drawings to receive grout topping	F
Garage and storage area floors	G
Precast concrete form panels, hollow core planks, double tees	J

** Finish shall be acceptable to the coating applicator and manufacturer. See Section 09900 entitled "Painting".*

- END OF SECTION -

SECTION 03370 - CONCRETE CURING

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The CONTRACTOR shall protect all freshly deposited concrete from premature drying and excessively hot or cold temperatures, and maintain with minimal moisture loss at a relatively constant temperature for the period of time necessary for the hydration of the cement and proper hardening of the concrete in accordance with requirements specified herein.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 03100 - Concrete Framework
- B. Section 03290 - Joints in Concrete
- C. Section 03300 - Cast-in-Place Concrete
- D. Section 03315 - Grout
- E. Section 03350 - Concrete Finishes

1.03 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the Section entitled "Submittals", the CONTRACTOR shall submit the following:
 - 1. Proposed procedures for protection of concrete under wet weather placement conditions.
 - 2. Proposed procedures for hot and cold weather placement.
 - 3. Proposed procedures for protection and curing of concrete during normal conditions.
 - 4. Proposed materials and procedures for moisture preservation.
 - 5. Proposed method of measuring concrete surface temperature changes.
 - 6. Manufacturer's literature and material certification for proposed curing compounds.

1.04 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Without limiting the generality of other requirements of these specifications all work hereunder shall conform to the applicable requirements of the referenced portions of the following documents, to the extent that the requirements therein are not in conflict with the provisions of this Section.
 - 1. ACI 301 Specifications for Structural Concrete for buildings

2. ACI 304 Guide for Measuring, Mixing, Transporting, and Placing Concrete, ACI 304
3. ACI 305 Hot Weather Concreting
4. ACI 306 Cold Weather Concreting
5. ACI 308 Standard Practice for Curing Concrete
6. ASTM C171 Specifications for Sheet Materials for Curing Concrete
7. ASTM C309 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

1.05 QUALITY ASSURANCE

- A. Curing compound shall not be used on any surface where concrete, coatings, or other material will be bonded unless the manufacturer certifies that the curing compound will not prevent bond or indicates measures to be taken to completely remove the curing compound from areas to receive bonded applications, and specifically approved by the ENGINEER.
- B. Care shall be taken to ensure that curing compounds are compatible with all finish concrete castings.
- C. Curing compounds 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.

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 300 sq.ft./gal. Manufacturer's certification is required. Acceptable products are Super Diamond Clear VOX by the Euclid Chemical Company, MasteKure CC 300 SB by BASF Master Builder Solutions, and Cure & Seal 30 Plus by Symons Corporation.
- 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 BASF, "MasterKure ER 50", or Euclid Chemical "Euco-Bar".

2.03 BURLAP MATS

- A. Burlap mats shall conform to AASHTO M-182.

PART 3 -- EXECUTION

3.01 PROTECTION AND CURING

- A. All concrete work 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, provision 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, 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 five days. Use of curing compound will not be acceptable for applications of this type.
- D. After placing and finishing, use one or more of the following methods to preserve moisture in concrete:
 - 1. Ponding or continuous fogging or sprinkling.
 - 2. Application of mats or fabric kept continuously wet.
 - 3. Continuous application of steam (under 150 degrees Fahrenheit).
 - 4. Application of sheet materials conforming to ASTM C171.
 - 5. If approved by the ENGINEER, application of a curing compound in accordance with Article 3.05. Apply the compound in accordance with the manufacturer's recommendation on after water sheen has disappeared from the concrete surface and after finishing operations. The rate of application shall not exceed 200 square feet per gallon. For rough surfaces, apply in two directions at right angles to each other.
- E. Keep absorbent forms wet until they are removed. After form removal, cure concrete 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 CONCRETE TEMPERATURE

- A. When the average of the highest and lowest temperature during the period from midnight to midnight is expected to drop below 40 F for more than three successive days, concrete shall be delivered to meet the following minimum temperature immediately after placement:
 - 1. 55 degrees Fahrenheit for sections less than 12 in. in the least dimension

2. 50 degrees Fahrenheit for sections 12 in. to 36 in. in the least dimension
 3. 45 degrees Fahrenheit for sections 36 in. to 72 in. in the least dimension
 4. 40 degrees Fahrenheit for sections greater than 72 in. in the least dimension
- B. The temperature of concrete as placed shall not exceed these values by more than 20 degrees Fahrenheit.
- C. These minimum requirements may be terminated when temperatures above 50 degrees Fahrenheit occur during more than half of any 24 hour duration.
- D. Unless otherwise specified or permitted, the temperature of concrete as delivered shall not exceed 90 degrees Fahrenheit.
- E. During and following curing, do not allow the surface of the concrete to change temperature more than the following:
1. 50 degrees Fahrenheit in any 24-hr period for sections less than 12 in. in the least dimension
 2. 40 degrees Fahrenheit for sections from 12 to 36 in. in the least dimension
 3. 30 degrees Fahrenheit for sections 36 to 72 in. in the least dimension
 4. 20 degrees Fahrenheit for sections greater than 72 in. in the least dimension

3.03 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 Article 3.02 herein.. 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 ground granulated blast furnace slag. 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.

3.04 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 sun shades 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 3.01C 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 four (4) 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.

3.05 USE OF CURING COMPOUND

- A. Curing compound shall be used only where specifically approved by the ENGINEER. Curing compound shall not be used on surfaces to receive subsequent coatings. 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 five 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 period, and the subsequent appearance of the concrete surface shall not be affected.
- C. The compound shall be applied in accordance with the manufacturer's recommendations after water sheen has disappeared from the concrete surface and after finishing operations. The rate of application shall not exceed 300 square feet per gallon. For rough surfaces, apply in two directions at right angles to each other.

3.05. EARLY TERMINATION OF CURING

- A. Moisture retention measures may be terminated earlier than the specified times only when at least one of the following conditions is met:
 - 1. The strength of the concrete reaches 85 percent of the specified 28-day compressive strength in laboratory-cured cylinders representative of the concrete in place, and the temperature of the in-place concrete has been constantly maintained at 50 degrees Fahrenheit or higher.

2. The strength of concrete reaches the specified 28-day compressive strength as determined by accepted nondestructive methods or laboratory-cured cylinder test results.

- END OF SECTION -

SECTION 03400 - PRECAST CONCRETE, GENERAL

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 03200 – Concrete Reinforcement
- B. Section 03315 – Grout
- C. Section 03300 – Cast-in-Place Concrete
- D. Section 03350 – Concrete Finishes
- E. Section 03370 – Concrete Curing
- F. Section 05500 – Metal Fabrications

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 end of the Bid.
 - 1. Florida Building Code.
 - 2. ACI 318-Building Code Requirements for Structural Concrete.
 - 3. PCI Standard MNL-116 - Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products.
 - 4. PCI Design Handbook.

1.04 SUBMITTALS

- A. The CONTRACTOR shall submit the following for review in accordance with the Section entitled "Submittals."
 - 1. Shop drawings for all precast concrete items showing all dimensions, locations, and type of lifting inserts, and details of reinforcement and joints.

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, shall be submitted. Calculations shall be signed and sealed by a Professional Engineer registered 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, checks, 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 of 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 only required for plants providing prestressed structural members such as hollow core planks, double T members, etc. In lieu of such certification, the manufacturer shall, at their expense, meet the following requirements:
 1. Retain independent testing or consulting firm approved by the architect/ENGINEER and/or OWNER.
 2. The basis of inspection shall be the Prestressed Concrete Institute Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products, MNL-116.
 3. This firm shall inspect the precast plant at two-week intervals during production and issue a report, certified by a registered engineer verifying that materials, methods, products and quality control meet all the requirements of the specifications, drawings, and MNL-116. If the report indicates to the contrary, the ENGINEER, at Precaster expense, will inspect and may reject any or all products produced during the period of non-compliance with the above requirements.
- C. Plant production and engineering must be under direct supervision and control of an engineer who possesses a minimum of three (3) years' experience in precast concrete work.

PART 2 – PRODUCTS

2.01 CONCRETE

- A. Concrete materials including Portland cement, aggregates, water, and admixtures shall conform to the Section entitled "Cast-in-Place Concrete."
- 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.
- C. For non-prestressed concrete items, minimum compressive strength of concrete at 28 days shall be 4,000 psi unless otherwise specified.

2.02 GROUT

- A. Grout for joints between panels shall be a non-shrink, non-metallic grout in conformance with the Section entitled "Grout."
- B. Minimum compressive strength of grout at 7 days shall be 3,000 psi.

2.03 REINFORCING STEEL

- A. Reinforcing steel used for precast concrete construction shall conform to the Section entitled "Concrete Reinforcement."

2.04 PRESTRESSING STRANDS

- A. Prestressing strands shall be 7-wire, stress-relieved, high-strength strands Grade 250K or 270K.

2.05 STEEL INSERTS

- A. Steel inserts shall be in accordance with the Section entitled "Metal Fabrications."
- B. All steel inserts protruding from or occurring at the surface of precast units shall be galvanized in accordance with the Section entitled "Galvanizing."

2.06 WELDING

- A. Welding shall conform to the Section entitled "Metal Fabrications."

2.07 BEARING PADS

- A. 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 with the form work system. Form materials shall be steel and the systems free from leakage during the casting operation.
- B. All cover of reinforcing shall be the same as detailed on the Drawings.
- C. 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.
- D. The CONTRACTOR shall coordinate the communication of all necessary information concerning openings, sleeves, or inserts to the manufacturer of the precast members.
- E. Concrete shall be finished in accordance with the Section entitled "Concrete Finishes." All recesses due to cut tendons shall be grouted.
- F. Curing of precast members shall be in accordance with the Section entitled "Concrete Curing."
- G. The manufacturer shall provide lifting inserts.

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 five (5) days has elapsed since casting, unless otherwise permitted by the ENGINEER.
- 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 their supervision using labor, equipment, tools and materials required for proper execution of the work.
- B. The 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 the Section entitled "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 -

SECTION 03732 - CONCRETE REPAIRS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The CONTRACTOR shall furnish all materials, labor, equipment, tools, etc., required for the repair, renovation, and replacement of concrete and/or reinforcing steel as indicated on the Drawings, specified herein, and determined by field survey.
- B. The work specified herein covers many types of concrete repairs that may or may not be needed in the contract. The Contractor shall refer to the Drawings for the scope of the concrete repair work and conform such repair work to the applicable provisions of this specification.
- C. The CONTRACTOR, in conjunction with the ENGINEER, shall determine the extent of repairs to be performed. A summary of the work to be performed shall be submitted to the ENGINEER for review, and such summary shall be approved by the ENGINEER prior to commencement of the Work.
- D. Concrete rehabilitation shall include cutting, surface preparation, concrete repair work, reinforcement replacement (if needed), proper disposal of all debris and all other work required to complete structural rehabilitation of the interior concrete surfaces of each structure to its original profile.
- E. Concrete repairs specified herein include the following work depicted on the Drawings:
 - 1. Repair of concrete in RAS Pump Station No. 1, Clarifier No. 2 effluent trough, Oxygenation Train 1 and 2 basins, damage caused during demolition work, and other areas as indicated on the drawings.

1.02 SUBCONTRACTOR/APPLICATOR QUALIFICATIONS

- A. The CONTRACTOR shall furnish the name of all subcontractors/applicators/manufacturers which he proposes to use for this work, including necessary evidence and/or experience records to ascertain their qualifications in the pressure application of epoxy, urethane, and polymer-modified mortars and grouts. Approved applicator qualifications shall include:
 - 1. A minimum of 5 years experience in applying materials similar to those specified in this Section.
 - 2. A letter from the manufacturer of the specified materials, on the manufacturer's letterhead, signed by an officer of the company, stating that the subcontractor/applicator has been trained in the proper techniques for applying the product, including surface preparation and mixing, placing, curing, and caring for the manufacturer's products. This letter shall further state that the subcontractor/applicator is on the manufacturer's approved list of contractors.

1.03 SUBMITTALS

- A. Material certifications and technical data sheets on all repair products specified in this Section. Field measure joint widths and propose expansion joint covers that would properly fit the application.
- B. Subcontractor/Applicator qualifications as specified in Section 1.02.
- C. A rehabilitation plan detailing the methods, materials, and procedures proposed for the rehabilitation of the facilities.
- D. Shop Drawings detailing any planned deviation from the proposed construction sequence and/or method of repair.

1.04 ADDITIONAL GUARANTEE

- A. The CONTRACTOR shall guarantee all repair work performed under this Contract against defects in workmanship for a period of two years from the date of the Certificate of Substantial Completion.

PART 2 -- PRODUCTS

2.01 WATER

- A. The water used for mixing concrete repair products shall be clear, potable, and free of deleterious substances.

2.02 AGGREGATE

- A. All aggregate shall conform to ASTM C-33. The aggregate supplier shall submit to the ENGINEER documentation that the proposed aggregates comply with ASTM C-33 and the requirements listed below:
- B. Pea Gravel - Pea gravel shall meet the gradation and material requirements of Standard Size 14 as defined by ASTM C-33. Pea gravel shall be clean and free from deleterious matter and shall contain no limestone.

2.03 EPOXY BONDING AGENT

- A. An epoxy bonding agent shall be used when applying repair mortar to existing concrete. Epoxy bonding agent shall conform to ASTM C-881 Type I, II, IV or V; Grade 2 for epoxy resin adhesives, depending on the application. The class of epoxy bonding agent shall be suitable for all ambient and substrate temperatures. The epoxy resin shall be "Sikadur Hi-Mod Series" as manufactured by the Sika Corp, Lyndhurst, NJ, "CR 246" as manufactured by Sto Corporation, Atlanta, GA, "Duralbond" as manufactured by Euclid Chemical Company, Cleveland, OH, "Euco #452 Series" by the Euclid Chemical Company, or "MasterEmaco ADH Series" by BASF Master Builder Solutions.

2.04 ANTI-CORROSION REBAR COATING

- A. All reinforcing steel cut or exposed during demolition and/or repair operations shall be protected with an anti-corrosive coating. The anti-corrosive coating shall be a two-component, polymer-modified cementitious material such as "Sika Armatec 110 EpoCem" manufactured by Sika Corp., Lyndhurst, NJ, "CR 246" manufactured by Sto Corporation, Atlanta, GA, "Corr-Bond" by the Euclid Chemical Company, or "MBT Emaco P124" by BASF Master Builder Solutions.

2.05 STRUCTURAL CRACK REPAIR MATERIAL

- A. Structural crack repair material shall be a two-component, polymer-modified or silica fume enhanced cementitious mortar and shall conform to EPA/USPHS standards for surface contact with potable water supplies. Structural crack repair material shall be "Sikatop 123 Plus" manufactured by Sika Corp., Lyndhurst, NJ, or "Emaco S88 CI" or "MasterSeal 590" by BASF Master Builder Solutions.

2.06 EPOXY CRACK REPAIR BINDER

- A. Epoxy crack repair binder shall be a two-component, 100% solids, high-modulus, low viscosity epoxy adhesive designed for structural repair. The epoxy adhesive shall be "Sikadur 52" manufactured by Sika Corp., Lyndhurst, NJ, "Duralcrete LV" manufactured by Euclid Chemical Company, Cleveland, OH, "Sto Poxxy Binder CR633" manufactured by Sto Corporation, Atlanta, GA, "Eucopoxy Injection Resin" by the Euclid Chemical Company, or "MasterInject 1500" by BASF Master Builder Solutions.

2.07 WATERPROOF INJECTION GROUT

- A. Waterproof crack repair material shall be polyurethane hydrophilic/hydrophobic injection grout capable of 700% expansion. Polyurethane grout shall form a tough flexible/rigid foam seal that is impenetrable to water. Hydrophilic injection grout shall be "Prime Flex 900 XLV" manufactured by Prime Resins, Conyers, GA, "AV-333 Injectaflex" manufactured by Avanti International, Webster, TX, or "DeNeef Sealfoam" manufactured by Grace Construction Products. Hydrophobic injection grout shall be "Prime Flex 920" manufactured by Prime Resins, Conyers, GA, "Sikafix HHLV" or "Sikafix HH+" manufactured by Sika Corp., Lyndhurst, NJ, or "DeNeef Flex PUR" manufactured by Grace Construction Products.

2.08 SPALL REPAIR PATCHING MATERIAL

- A. Spall repairs not requiring formwork shall be repaired using a two-component, polymer-modified cementitious mortar and shall have a minimum 28-day compressive strength of 7,000 psi. Spall repair mortar for use in horizontal applications shall be "Sikatop 122 Plus" manufactured by Sika Corp., Lyndhurst, NJ, "CR 700" manufactured by Sto Corporation, Atlanta, GA, "Eucocrete Supreme" by the Euclid Chemical Company, or "MBT SD-2" or "Emaco R310" by BASF Master Builder Solutions. Spall repair mortar for use in vertical applications shall be "Sikatop 123 Plus" manufactured by Sika Corp., Lyndhurst, NJ, "Duraltop Gel" manufactured by Tamms Industries, Mentor, OH, "CR 702" manufactured by Sto Concrete Restoration Division, Atlanta, GA, "Verticoat or Verticoat Supreme" by the Euclid Chemical Company, or "MasterEmaco N425" or "MasterEmaco N400" by BASF Master Builder Solutions.

- B. Spall repairs requiring formwork shall be repaired using a two-component, polymer-modified cementitious mortar/pea gravel mixture and shall have a minimum 28-day compressive strength of 7,000 psi. Spall repair mortar shall be "SikaTop 111 PLUS" manufactured by Sika Corp., Lyndhurst, NJ, "Eucocrete Supreme" manufactured by Euclid Chemical Company, Cleveland, OH, "Sto Flowable Mortar CR730" manufactured by Sto Corporation, Atlanta, GA., or "MasterEmaco T310CI" by BASF Master Builder Solutions.

2.09 WATERPROOF MEMBRANE PATCH

- A. Waterproof membrane patch shall be a hypalon sealing strip secured to the concrete substrate with an epoxy adhesive. Sealing system shall be installed per manufacturer's recommendations and shall be "Sikadur Combiflex" manufactured by Sika Corp., Lyndhurst, NJ.

2.10 CEMENT BASED TEXTURED COATING

- A. Cement based textured coating shall be "SikaTop 144" manufactured by Sika Corp., Lyndhurst, NJ, "Thoroseal/Acryl 60" manufactured by BASF Construction Chemicals, "Duraltop Coating" manufactured by Euclid Chemical Company, Cleveland, OH, "Eucoseal or Tamoseal" by the Euclid Chemical Company.

2.11 CRYSTALLINE WATERPROOFING

- A. Crystalline Waterproofing: Concrete waterproofing material of the cementitious crystalline type that chemically and permanently fixes non-soluble crystalline growth throughout the capillary voids of the concrete. Crystalline waterproofing shall be as manufactured by Xypex Chemical Corporation or equal.

2.12 EXPANSION JOINT REPAIR MATERIALS

- A. At locations shown on the drawings, the top portion of expansion joint filler materials shall be replaced with a foam seal. The foam seal shall be Ethylene Vinyl Acetate (EVA) foam seal by Balco or equal.
- B. Where specified on the Drawings, an aluminum cover shall be installed over the sealed expansion joint. The cover shall be NBAF by Balco, or equal.

2.13 JOINT SEALANT

- A. Sealants used to seal concrete joints where indicated on the Drawings shall be Type 2 as specified in Section 07920.

2.14 STORAGE OF MATERIALS

- A. The CONTRACTOR shall provide an area for repair material storage free from exposure to moisture in any form, before, during, and after delivery to the site. Manufactured materials shall be delivered in unbroken containers labeled with the manufacturer's name and product type. All mortar products shall be stored on raised platforms. Materials susceptible to damage by freezing shall be stored in a dry, heated, insulated area. Any material that has hardened, partially set, become caked and/or has been contaminated or

deteriorated shall be rejected. All aggregates shall be stored in clean bins, scows or platforms.

PART 3 – EXECUTION

3.01 GENERAL REQUIREMENTS

- A. No repair work shall be undertaken when ambient temperatures are below manufacturer's safe recommendations. No admixtures, except those required by the manufacturer, shall be used in the repairs specified herein. All products shall be applied in strict accordance with manufacturer's recommendations. The CONTRACTOR shall furnish and install safe scaffolding and ladders for the ENGINEER'S prework inspection, the repair work activities, and the ENGINEER'S final inspection
- B. Sandblast or waterblast (3000-4000 psi waterjet) deteriorated areas to remove all loose concrete, existing coatings, unsound material, debris, and laitance. All surfaces shall be clean, free of dirt, grease, loose particles, and deleterious substances and shall be prepared according to manufacturer's requirements.

3.02 EPOXY BONDING AGENT

- A. Existing concrete surfaces shall be roughened prior to application of bonding agent. Concrete surface shall be clean and sound, free of all foreign particles and laitance. Repair material shall be placed while bonding agent is still tacky. If bonding agent cures prior to placement of repair material, bonding agent shall be reapplied.
- B. Repairing concrete with epoxy mortars shall conform to all the requirements of ACI 503.4 "Standard Specification for Repairing Concrete with Epoxy Mortars" (latest edition), except as modified herein.

3.03 ANTI-CORROSION REBAR COATING

- A. Reinforcing steel cut or exposed during demolition and/or repair operations shall be sandblasted and cleaned prior to coating with an anti-corrosive coating. Coating shall thoroughly cover all exposed parts of the steel and shall be applied according to manufacturer's recommendations.

3.04 STRUCTURAL CRACK REPAIR MATERIAL

- A. Where indicated on the Drawings or as determined by the field survey per Article 1.01-B, existing structural cracks 1/16" and wider shall be repaired with a structural crack repair material. Rout crack to 3/4" wide by 3/4" deep V-notch to expose sound concrete. Where rebar has deteriorated, crack shall be routed to expose 3/4" all around rebar. The resulting void in concrete shall be patched flush with the existing concrete surface using structural crack repair material.

3.05 EPOXY CRACK REPAIR BINDER

- A. Where indicated on the Drawings or as determined by the field survey per Article 1.01-B, existing structural cracks 1/4" or smaller shall be repaired by pressure injecting an epoxy

crack repair binder into the prepared crack. Seal crack surface and install injection ports per manufacturer's recommendations. Holes drilled for injection ports shall not cut rebar. If rebar is encountered during drilling, the hole shall be abandoned and relocated, and the abandoned hole shall be patched immediately with non-shrink grout flush with the surface of the existing concrete. Once the surface sealing material has cured, inject crack with epoxy crack repair binder using standard pressure injection equipment as directed by the manufacturer.

- B. Where indicated on the Drawings or as determined by the field survey per Article 1.01-B, all existing structural cracks wider than 1/4" shall be repaired by gravity feeding an epoxy crack repair binder into the prepared crack. First rout the concrete surface to form a 1/4" wide by 1/4" deep v-notch and clean the crack to remove all loose and foreign particles. Fill the crack with clean, dry sand and then pour epoxy crack repair binder into V-notch, completely filling crack. As binder penetrates into crack, additional binder shall be applied to the V-notch.

3.06 WATERPROOF INJECTION GROUT

- A. Where indicated on the Drawings or as determined by the field survey per Article 1.01-B, existing, leaking cracks 1/4" or smaller shall be repaired by pressure injecting a waterproof injection grout into the prepared crack. Seal crack surface and install injection ports per manufacturer's recommendations. Holes drilled for injection ports shall not cut rebar. If rebar is encountered during drilling, the hole shall be abandoned and relocated, and the abandoned hole shall be patched immediately with non-shrink grout flush with the surface of the existing concrete. Once the surface sealing material has cured, inject crack with waterproof injection grout using standard pressure injection equipment as directed by the manufacturer.

3.07 SPALL REPAIR PATCHING MATERIAL

- A. Where shown on the drawings or as determined by the field survey per Article 1.01-B, voids or spalled areas to be repaired shall be chipped back to sound concrete a minimum 1/2" deep, cleaned and repaired with spall repair patching material according to manufacturer's recommendations. All patching shall provide a final finished surface which is flat, level and even with the existing concrete surface. Repair mortar shall not be feathered to meet existing concrete surface. Final patching on horizontal surfaces shall receive a broom finish consistent with the finish on the existing structure.

3.08 WATERPROOF MEMBRANE PATCH

- A. Thoroughly clean the concrete substrate and apply waterproof membrane patch according to manufacturer's recommendations.

3.09 CEMENT BASED TEXTURED COATING

- A. Thoroughly clean the concrete substrate and apply cement based textured coating according to manufacturer's recommendations. All necessary concrete repairs as detailed on the Contract Drawings shall be completed prior to applying coating.

3.10 CRYSTALLINE WATERPROOFING

- A. Crystalline waterproofing shall be applied to “green” or existing concrete which has been thoroughly saturated with clean water. Prepare surfaces in strict accordance with manufacturer’s recommendations and instructions. Mix and apply in accordance with manufacturer’s literature.
- B. An independent NACE Level 3 inspector will be selected by the CITY to observe the surface preparation and coating application as required. The CONTRACTOR and applicator shall schedule the work so as to permit a reasonable time for inspection before proceeding with application of materials and shall keep the inspector informed of its progress.
- C. The cost of all inspections by the NACE Level 3 inspector specified herein will be paid for through an allowance account described in the Bid Schedule. However, the CONTRACTOR shall be charged for the cost of any additional inspections on work which does not meet the specifications.
- D. The following minimum inspections by the NACE Level 3 Inspector shall be provided:
 - 1. Inspection of all concrete surfaces which have been prepared for coating application.
 - 2. Inspection of finished coating system.

3.11 EXPANSION JOINT REPAIR

- A. Expansion joint repair shall commence by saw cutting the concrete substrate on each side of the joint as shown on the Drawings. The depth shall be coordinated with the plate cover manufacturer’s requirements.
- B. The concrete shall be chipped down using appropriate mechanical chipping hammer to provide a seat for the cover plate.
- C. Existing joint filler in the joint shall then be removed to a depth of approximately 4 inches.
- D. The resulting groove in the expansion joint shall be filled with the EVA foam seal.
- E. The frame of the aluminum expansion joint cover shall be placed, leveled and screwed in place. A cementitious pre-packaged grout shall be placed to set the frame in position.
- F. The aluminum cover shall then be bolted on the frame. Provide adequate overlaps of the covers at interface with vertical expansion joint covers and at horizontal joints of the covers.

3.12 CURING

- A. All repair products shall be cured in strict accordance with manufacturer recommendations.

3.13 WORK IN CONFINED SPACES

- A. The CONTRACTOR shall provide and maintain safe working conditions for all employees and subcontractors. Fresh air shall be supplied continuously to confined spaces through the combined use of existing openings, forced-draft fans and temporary ducts to the outside, or by direct air supply to individual workers. Fumes shall be exhausted to the outside from the lowest level of the confined space. Electrical fan motors shall be explosion-proof if in contact with fumes. No smoking or open fires shall be permitted in or near areas where volatile fumes may accumulate.

- END OF SECTION -

DIVISION 4 – MASONRY

NOT USED

DIVISION 5 – METALS

SECTION 05010 - 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 05050 entitled "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/A572M-94C | Standard Specification for High Strength Low-Alloy Columbium-Vanadium Structural Steel Grade 50 |
| O. | ASTM A666 | Standard Specification for Austenitic Stainless Steel, Sheet, Strip, Plate, and Flat Bar for Structural Applications |
| P. | ASTM B26 | Standard Specification for Aluminum-Alloy Sand Castings |
| Q. | ASTM B85 | Standard Specification for Aluminum-Alloy Die Castings |
| R. | ASTM B108 | Standard Specification for Aluminum-Alloy Permanent Mold Castings |
| S. | ASTM B138 | Standard Specification for Manganese Bronze Rod, Bar, and Shapes |
| T. | ASTM B209 | Standard Specification for Aluminum-Alloy Sheet and Plate |
| U. | ASTM B221 | Standard Specification for Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes |
| V. | ASTM B308 | Standard Specification for Aluminum-Alloy Standard Structural Shapes, Rolled or Extruded |
| W. | ASTM B574 | Standard Specification for Nickel-Molybdenum-Chromium Alloy Rod |
| X. | ASTM F468 | Standard Specification for Nonferrous Bolts, Hex Cap Screws, and Studs for General Use |

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. CITY 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 CITY. 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 CITY. 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:

- | | |
|---|-------------------------------------|
| 1. Structural W Shapes | A 992 (50 ksi) |
| 2. Structural S, M, C, L Shapes | A 36 (36 ksi) |
| 3. Structural HP Shape | A 572, Grade 50 (50 ksi) |
| 4. Structural Tubing | A 500, Grade B or A 501 (42 ksi) |
| 5. Structural Pipe | A 53, Type E or S, Grade B (35 ksi) |
| 6. Plates and Bars | A 36 U.N.O. (36 ksi) |
| 7. Sheet Steel | A 570, Grade C |
| 8. Cold-Formed Structural Studs and Joists
(18-22 gauge) | A 446, Grade C |
| 8. Cold-Formed Structural Studs and Joists
(12-16 gauge) | A 446, Grade D |

2.02 STAINLESS STEEL

A. All stainless steel fabrications shall be Type 316.

B. Material types and ASTM designations are listed below:

- | | |
|----------------------|---------------------------|
| 1. Plates and Sheets | ASTM A167 or A666 Grade A |
| 2. Structural Shapes | ASTM A276 |

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:

- | | |
|----------------------|------------------------|
| 1. Structural Shapes | ASTM B308 |
| 2. Castings | ASTM B26, B85, or B108 |
| 3. Extruded Bars | ASTM B221 - Alloy 6061 |

- | | |
|------------------------------------|------------------------|
| 4. Extruded Rods, Shapes and Tubes | ASTM B221 - Alloy 6063 |
| 5. Plates | ASTM B209 - Alloy 6061 |
| 6. Sheets | ASTM B221 - Alloy 3003 |

- C. All aluminum shall be provided with mill finish unless otherwise noted.
- D. Where bolted connections are indicated, aluminum shall be fastened with Type 316 stainless steel bolts.
- E. Aluminum in contact with dissimilar materials shall be insulated with an approved dielectric.

2.04 CAST IRON

- A. Material types and ASTM designations are listed below:

- | | |
|--------------|--------------------------|
| 1. Gray | ASTM A48 Class 30B |
| 2. Malleable | ASTM A47 |
| 3. Ductile | ASTM A536 Grade 60-40-18 |

2.05 BRONZE

- A. Material types and ASTM designations are listed below:

- | | |
|--------------------------|--------------------------|
| 1. Rods, Bars and Sheets | ASTM B138 - Alloy B Soft |
|--------------------------|--------------------------|

2.06 HASTELLOY

- A. All Hastelloy shall be Alloy C-276.

PART 3 -- EXECUTION

(NOT USED)

- END OF SECTION -

SECTION 05050 - METAL FASTENING

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The CONTRACTOR shall 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 05010 - 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 | |
| 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. | AISC 348 | The 2009 RCSC Specification for Structural Joints |
| 7. | AISC | Specification for Structural Joints Using ASTM A325 or A490 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 A307	Standard Specification for Carbon Steel Externally Threaded Standard Fasteners
16.	ASTM A325	Standard Specification for High-Strength Bolts for Structural Steel Joints
17.	ASTM E488	Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements
18.	ASTM F436	Standard Specification for Hardened Steel Washers
19.	ASTM A489	Standard Specification for Eyebolts
20.	ASTM A490	Standard Specification for Quenched and Tempered Alloy Steel Bolts for Structural Steel Joints
21.	ASTM A563	Standard Specifications for Carbon and Alloy Steel Nuts
22.	ASTM F593	Standard Specification for Stainless Steel Bolts; Hex Cap Screws, and Studs
23.	ASTM F594	Standard Specification for Stainless Steel Nuts
24.	ASTM D1785	Standard Specification for Polyvinyl Chloride (PVC) Plastic Pipe
25.	ASTM F1554	Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength

1.04 SUBMITTALS

A. Submit the following items in accordance with Section 01300 entitled "Submittals":

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. Manufacturer's installation instructions.
4. Welder certifications for each person who is to perform field welding. Certifications shall be from a recognized testing laboratory.

5. Certified weld inspection reports, when required.
6. Welding procedures.
7. Installer qualifications of post-installed anchors
8. Certification of Installer Training
9. Inspection Reports
10. Results of Anchor Proof Testing
11. For outdoor equipment, anchorage calculations to resist design wind loads, signed and sealed by a Professional Engineer registered in the State of Florida.

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. Installer Qualifications: All concrete anchors shall be installed by an Installer with at least three years of experience performing similar installations. Installer shall be certified as an Adhesive Anchor Installer in accordance with ACI-CRSI Adhesive Anchor Installation Certification Program.
- C. Installer Training: For concrete adhesive 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 for drilled-in anchors, 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. Rebar doweling preparation and installation.
 5. Proof loading/torquing.
- D. 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.
- E. Welds and high strength bolts used in connections of structural steel will be visually inspected in accordance with Article 3.04 of this Section.

- F. The CITY 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 CITY.
- G. 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.
- H. 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 (ANCHOR BOLTS)

- A. For all conditions throughout this Contract, all anchor bolts shall be Type 316 stainless steel conforming to ASTM F-593 unless noted otherwise.
- B. Nuts shall conform to ASTM F-594, alloy 316.
- C. Where anchor rods are used to anchor galvanized steel or are otherwise specified to be galvanized, anchor rods and nuts shall be hot-dip 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 80 PVC plastic piping meeting the requirements of ASTM D1785, unless noted otherwise.
- E. Equipment manufacturers, fabricators, and suppliers shall design and furnish anchor bolts as required to install the supplied units. The anchor bolt layout shall be coordinated with concrete work as specified herein.
- F. Drilled in type anchor bolts, either adhesive types or mechanical types shall not be used unless approved in writing by the manufacturer/fabricator of equipment or covers, subject to acceptance by the ENGINEER. All operating pieces of equipment such as pumps, generators, motors etc. shall not be anchored with wedge anchors or other mechanical anchors. Drilled in type anchor bolts shall be Type 316 stainless steel. Drilled in type anchor bolts are specified under Article 2.04 of this Section entitled "Concrete Anchors".

2.02 HIGH STRENGTH BOLTS

- A. High strength bolts and associated nuts and washers shall be in accordance with ASTM A325 or ASTM A490. Bolts, nuts and washers shall meet the requirements of AISC "Specification for Structural Joints Using ASTM A325 or A490 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-dip galvanized in accordance with ASTM A325.

2.03 STAINLESS STEEL BOLTS

- A. Stainless steel bolts shall conform to ASTM F-593. All underwater fasteners shall be Type 316 stainless steel. Unless otherwise specified, fasteners for aluminum and stainless steel members shall be Type 316 stainless steel.
- 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 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. Unless otherwise noted, all concrete anchors which are submerged, or are used in hanging items or have direct tension induced upon them, or which are subject to vibration from equipment such as pumps and generators, shall be adhesive anchors. The determination of anchors equivalent to those listed below shall be on the basis of test data performed by an approved independent testing laboratory. There are two types used:
 - a. Expansion anchors shall be mechanical anchors of the wedge, sleeve, drop-in or undercut type.
 - 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. Expansion anchors shall not be used to hang items from above or in any other situation where direct tension forces are induced in anchor.
3. Unless otherwise noted, all concrete anchors which are submerged or are used in hanging items or have direct tension induced upon them, or which are subject to vibration from equipment such as pumps and generators, shall be adhesive anchors.
4. Adhesive anchors shall conform to the requirements of ACI 355.4 or alternately to AC308. Expansion or mechanical anchors shall conform to the requirements of ACI 355.2 or alternately to AC 193.
5. 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 loads only, or anchor non-structural elements.

B. Concrete Anchor Design"

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, it shall be considered an engineered design and 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 anchors will be considered an engineered design and 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 by the Engineer on the Drawings, the Contractor shall provide the anchor design per the requirements listed below.

1. Structural Anchors: All concrete anchors shall be considered structural anchors if they transmit load between structural elements; transmit load between non-structural components that make up a portion of the structure and structural elements; or transmit load between life-safety related attachments and structural elements. Examples of structural concrete anchors include but are not limited to column anchor bolts, anchors supporting non-structural walls, sprinkler piping support anchors, anchors supporting heavy, suspended piping or equipment, anchors supporting barrier rails, etc. For structural anchors, the Contractor shall submit an engineered design with signed and sealed calculations performed by an Engineer currently registered in the State of Florida. Structural 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 Appendix D.
2. Non-Structural Anchors: All other concrete anchors may be considered non-structural concrete anchors. The Contractor shall perform an engineered design for non-structural anchors. The Engineer may request the Contractor provide anchor design details for review, but submission of a signed, sealed design is not required. Non-structural anchors shall be designed by the contractor for use in uncracked concrete.
3. Minimum anchor embedment shall be as indicated on the Drawings or determined by the Contractor's engineered design. 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/bolt (adhesive anchors).

C. Structural Anchors:

1. Mechanical Anchors:
 - a. Wedge Anchors: Wedge anchors shall be "Kwik Bolt TZ" by Hilti, Inc., "TruBolt +" by ITW Redhead, "Strong-Bolt" or "Strong-Bolt 2" by Simpson Strong-Tie Co. or "Powerstud SD-1" or "Powerstud SD-2" by Powers Fasteners.
 - b. Screw Anchors: Screw anchors shall be "Kwik HUS-EZ" and "KWIK HUS-EZ-I" by Hilti, Inc., "Titen HD" by Simpson Strong-Tie Co., or "Wedge-Bolt

+" by Powers Fasteners. Bits specifically provided by manufacturer of chosen system shall be used for installation of anchors.

- c. Sleeve Anchors: Sleeve anchors shall be "HSL-3 Heavy Duty Sleeve Anchor" by Hilti, Inc. or "Power-Bolt +" by Powers Fasteners.
- d. Undercut Anchors: Undercut anchors shall be "HDA Undercut Anchor" by Hilti, Inc., "Torq-Cut Undercut Anchor" by Simpson Strong-Tie Co., "Atomic + Undercut Anchor" by Powers Fasteners

2. Adhesive Anchors:

- a. Adhesive anchors shall be "Epcon C6+ Adhesive Anchoring System" by ITW Redhead, "HIT HY-200 Adhesive Anchoring System" by Hilti, Inc., "SET-XP Epoxy Adhesive Anchors" by Simpson Strong-Tie Co., or "Pure 110+ Epoxy Adhesive Anchor System" by Powers Fasteners.
- b. Structural 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. Structural adhesive anchor systems shall comply with the latest revision of ICC-ES Acceptance Criteria AC308, and shall have a valid ICC-ES report in accordance with the applicable building code. No or equal products will be considered unless prequalified and approved by the Engineer and Owner.

D. Non-Structural Anchors: In addition to the acceptable non-structural anchors listed below, all structural anchors listed above may also be used as non-structural anchors.

1. Mechanical Anchors:

- a. Wedge Anchors: Wedge anchors shall be "Kwik Bolt 3" by Hilti, Inc. or "TruBolt" by ITW Redhead.
- b. Screw Anchors: Screw anchors shall be "Kwik HUS" by Hilti, Inc., "Wedge-Bolt" by Powers Fasteners or "Large Diameter Tapcon (LDT) Anchor" by ITW Redhead. Bits specifically provided by manufacturer of chosen system shall be used for installation of anchors.
- c. Sleeve Anchors: Sleeve anchors shall be "HSL Heavy Duty Sleeve Anchors" by Hilti, Inc. "Power-Bolt" by Powers Fasteners or "Dynabolt Sleeve Anchor" by ITW Redhead.
- d. Drop-In Anchors: Drop-in anchors shall be "Drop-In" by Simpson Strong-Tie Co., "HDI Drop-In Anchor" by Hilti, Inc. or "Multi-Set II Drop-In Anchor" by ITW Redhead.

- e. Undercut Anchors: Undercut anchors shall be "HDA Undercut Anchor" by Hilti, Inc.
- 2. Adhesive Anchors:
 - a. Adhesive anchors shall be "Epcon A7" or "Epcon C6+ Adhesive Anchoring System" by ITW Redhead, "HIT HY-200 Adhesive Anchoring System" by Hilti, Inc., "SET Epoxy Tie High Strength Anchoring Adhesive" or "AT High Strength Anchoring Adhesive" by Simpson Strong-Tie Co., or "Powers AC 100+ Gold Vinylester Injection Adhesive Anchoring System" or "T308+ Epoxy Adhesive Injection System" by Powers Fasteners.
 - b. Non-structural adhesive anchors systems shall be IBC compliant and capable of resisting short term wind and seismic (Seismic Design Categories A and B) as well as long term and short term sustained static loads in uncracked concrete
 - c. Non-structural adhesive anchor embedment depth of the rod/bolt shall provide a minimum allowable bond strength that is equal to the allowable yield capacity of the rod/bolt unless noted otherwise on the Drawings.
 - d. No or equal products will be considered unless prequalified and approved by the Engineer and Owner.

E. Concrete Anchor Rod/Bolt 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 (f_y) less than 58 ksi nor an ultimate strength (f_u) 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 Type 304 stainless steel unless noted otherwise. All underwater concrete anchors shall be Type 316 stainless steel.
- 3. Nuts, 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 as specified above for concrete anchors.
- 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 with nylon (not wire) brush prior to installation of

adhesive and anchor. Contractor shall follow manufacturer's installation instructions. The adhesive system shall be "Epcon System A7 or C6" as manufactured by ITW Ramset/Redhead, "HIT HY-70 System" as manufactured by Hilti, Inc., "SET Epoxy-Tie" or "AT Acrylic-Tie" as manufactured by Simpson Strong-Tie Co., or "AC-100+ Gold by Powers Fasteners.

- 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. All masonry anchors shall be Type 316 stainless steel except 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 Type 316 stainless steel unless noted otherwise.

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 code.

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.

2.10 ANTISEIZE LUBRICANT

- A. Antiseize lubricant shall be Graphite 50 Anti-Seize by Loctite Corporation, 1000 Anti-Seize Paste by Dow Corning, 3M Lube and 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 BOLT INSTALLATION

A. Anchor Bolts, Concrete Anchors, and Masonry Anchors

1. Anchor bolts 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.
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 bolts without ENGINEER's approval.
4. All stainless steel threads shall be coated with antiseize 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 AISC "Specification for Structural Joints, using A325 or A490 Bolts." All high strength bolts installed by the "turn-of-nut" method shall have the turned portion marked with reference to the steel being connected after the nut has been made snug and prior to final tightening. These marks will be considered in inspection.
2. All stainless steel bolts shall be coated with antiseize lubricant.

C. Concrete Anchors

1. Concrete at time of anchor installation shall be a minimum age of 21 days.
2. Concrete anchors designed by the Contractor shall be classified as structural or non-structural based on the requirements indicated above.
3. Concrete Anchor Testing:
 - a. At all locations where concrete anchors meet the requirements for structural anchors at least 5 percent of all concrete anchors installed shall be proof tested to the value indicated on the Drawings, with a minimum of one tested anchor per anchor group. If no test value is indicated on the Drawings but the installed anchor meets the requirements for structural anchors, the Contractor shall notify the Engineer to allow verification of whether anchor load proof testing is required.
 - b. Contractor shall submit a plan and schedule indicating locations of anchors to be 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. Testing of anchors shall be in accordance with ASTM E488 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 anchorage design to be the Contractor's responsibility and the anchors are considered structural per the above criteria, 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 of Florida. The Contractor's Engineer shall also submit documentation indicating the Contractor's testing procedures have been reviewed and the proposed procedures are acceptable. Testing procedures shall be in accordance with ASTM E488.
 - 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 testing, including additional testing required due to previously failed tests.
- 4. 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.
 - 5. All holes shall be drilled with a carbide bit unless otherwise recommended by the manufacturer. No cored holes shall be allowed unless specifically approved by the Engineer. If coring holes is allowed by the manufacturer and approved by the Engineer, cored holes shall be roughened in accordance with manufacturer requirements. Thoroughly clean drill holes of all debris and drill dust with compressed air followed by a wire brush prior to installation of adhesive and threaded rod/bolt unless otherwise recommended by the manufacturer. Degree of hole dampness shall be in strict accordance with manufacturer recommendations. Where depth of hole exceeds the length of the static mixing nozzle, a plastic extension hose shall be used to ensure proper adhesive injection from the back of the hole. Injection of adhesive into the hole shall utilize a piston plug to minimize the formation of air pockets. Wipe rod free from oil that may be present from shipping or handling.

D. Other Bolts

- 1. All dissimilar metal shall be connected with appropriate fasteners and shall be insulated with a dielectric or approved equal. Unless otherwise specified, where aluminum and steel members are connected together they shall be fastened with Type 316 stainless steel bolts and insulated with micarta, nylon, rubber, or equal.

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.

3.04 INSPECTION

- A. High strength bolting will be visually inspected in accordance with AISC 348 "The 2009 RCSC Specification for Structural Joints". Rejected bolts shall be either replaced or retightened as required. In cases of disputed bolt installation, the bolts in question shall be checked by a calibrated wrench certified by an independent testing laboratory. The certification shall be at the CONTRACTOR's expense.
- 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. Inspection of post installed anchors shall be per requirements of the corresponding ICC ES ER.

- END OF SECTION -

SECTION 05500 - METAL FABRICATIONS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The CONTRACTOR shall furnish, fabricate, and install miscellaneous metalwork and appurtenances, complete, all in accordance with the requirements of the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 05050 - Metal Fastening
- B. Section 09900 - Painting

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 or exceed the requirements of the Florida Building Code and 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. American Society for Testing and Materials (ASTM), specifications as referred to herein.
 - 2. American Welding Society (AWS) "Structural Welding Code-Steel" (AWS D1.1) which includes qualification procedures for welders.
 - 3. American Institute of Steel Construction (AISC) "Specifications for the Design, Fabrication, and Erection of Structural Steel for Buildings" and "Commentary on the AISC Specification."
 - 4. American Iron and Steel Institute (AISI) "Specifications for the Design of Cold-Formed Steel Structural Members" and "Commentary on the AISI Specification."
 - 5. Occupational Safety and Health Administration (OSHA) Regulations.
 - 6. Aluminum Association "Specifications for Aluminum Structures" and "Engineering Data for Aluminum Structures."
 - 7. National Association of Architectural Metal Manufacturers "Metal Stairs Manual."
- B. References herein to "Building Code" shall mean the Florida Building Code.

1.04 SUBMITTALS

- A. Shop drawings of all miscellaneous metalwork shall be submitted to the ENGINEER for review in accordance with the Section 01300 entitled "Submittals."

- B. Safe working load capacity in tension and shear for each size and type of concrete anchor used shall be submitted to the ENGINEER for review.

PART 2 -- PRODUCTS

2.01 METAL MATERIALS

- A. Materials are specified in Section 05010 entitled "Metal Materials".

2.02 BOLTS, CONCRETE ANCHORS AND FASTENERS

- A. Bolts, concrete anchors and other fasteners are specified in Section 05050 entitled "Metal Fastening".

2.03 STEEL PIPE BUMPER GUARDS

- A. Steel pipe bumper guards shall be as detailed on the Drawings, including pipe sleeves, concrete fill, crushed fill and grouting to secure parts. Pipe for guards shall be galvanized steel, Schedule 40 pipe that conforms to ASTM A53. Painting shall be in accordance with Section 09900 entitled "Painting".
- B. Steel pipe bumper guards shall be concrete filled and crowned, as detailed on the Drawings.

PART 3 -- EXECUTION

3.01 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work.
- B. Beginning of installation means erector accepts existing conditions.

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 05050, Metal Fastening. All fastenings shall be concealed where practicable.
- G. Fabricated items shall be shop painted when specified in Section 09900, Painting.

3.02 PREPARATION

- A. Clean and strip primed steel items to bare metals where site welding is required.
- B. Supply items required to be cast into concrete with setting templates, to appropriate sections.

3.03 INSTALLATION

- A. Install items plumb and level, accurately fitted, free from distortion or defects.
- B. Allow for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
- C. Field weld components indicated on Drawings.
- D. Obtain ENGINEER approval prior to site cutting or making adjustments not scheduled.
- E. Fabrication and Erection: Except as otherwise shown, the fabrication and erection of structural steel shall conform to the requirements of the American Institute of Steel Construction "Manual of Steel Construction."

3.04 WELDING

- A. All welding shall be by the metal-arc method or gas-shielded arc method as described in the American Welding Society's "Welding Handbook" as supplemented by other pertinent standards of the AWS. Qualification of welders shall be in accordance with the AWS Standards governing same.
- B. In assembly and during welding, the component parts shall be adequately clamped, supported and restrained to minimize distortion and for control of dimensions. Weld reinforcement shall be as specified by the AWS Code. Upon completion of welding, all weld splatter, flux, slag, and burrs left by attachments shall be removed. Welds shall be repaired to produce a workmanlike appearance, with uniform weld contours and dimensions. All sharp comers of material which is to be painted or coated shall be ground to a minimum of 1/32-inch on the flat.

- END OF SECTION -

SECTION 05520 - HANDRAILS AND RAILINGS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The CONTRACTOR shall furnish, fabricate, and install handrails and railings and appurtenances, complete, all in accordance with the requirements of the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 05010 - Metal Materials
- B. Section 05500 - Metal Fabrications

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Without limiting the generality of the other requirements of the specifications, all work specified herein shall conform to or exceed the requirements of the Florida Building Code, and 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. 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. Shop drawings of all handrails and railings shall be submitted to the ENGINEER for review in accordance with Section 01300 entitled "Submittals."

1.05 QUALITY ASSURANCE

- A. Single-Source Responsibility: Obtain handrails and railing systems from a single manufacturer.

PART 2 -- PRODUCTS

2.01 ALUMINUM RAILING SYSTEM

- A. General: Where indicated on the Drawings, pipe guardrailing shall be provided. Pipe guardrailing and handrailing shall be supplied as required by the Florida Building Code and OSHA whether indicated on the Drawings or not, and shall consist of all railings, posts, toeboards, baseplates, anchors, and accessories required for a complete and rigid

installation.

1. All metal railing systems shall be fabricated from extruded aluminum alloy 6061-T6 or 6105-T5, with Aluminum Association M12C22A41 clear anodized finish, unless noted otherwise.
- B. Vertical pipe supports shall include cast aluminum base flange or side mount bracket with set screws as indicated on Drawings and as manufactured by Thompson Fabricating, Hollaender, or approved equal. Removable posts shall be sleeved.
- C. Wall brackets for handrail shall be of designs indicated on the Drawings and shall be as manufactured by Moultrie Manufacturing Company, J.G. Braun Company, Fulton Metal Products Company, or equal.
- D. All connections between vertical posts and horizontal railing or between sections of horizontal railings shall be shop welded continuous in as long of sections as practical. Tack welds shall not be accepted. All welds shall be water tight and ground smooth. Field assembly of welded sections may be made by mechanical fasteners. Location and type of field connections shall be subject to the ENGINEER's review. Weep holes shall be shop drilled in all vertical posts of external railing.
- E. Design Load: All components of the railings and the railing system shall be adequately designed to resist the design loads of the Florida Building Code. In no case shall the spacing of vertical pipe supports exceed five feet.
- F. Aluminum Railing: Guardrail railing Posts shall be nominal 1-1/2 inch nominal diameter, Schedule 80 (minimum) aluminum alloy 6061-T6. Horizontal guardrail railing shall be 1-1/2 inch nominal diameter, Schedule 40 (minimum) aluminum pipe sections. Handrail railing shall be a maximum 1-1/2 inch outer diameter, Schedule 40 (minimum) aluminum pipe section. Stainless steel railing may be used in lieu of aluminum railing at the CONTRACTOR's option at no additional cost to the CITY.
- G. Kickplates: Kickplates shall be furnished and installed typically at the edges of all walkways and at other handrail installations. Kickplates shall be 1/4-inch thick, must meet OSHA requirements, shall project 4-inches above walkway surface, may not infringe on minimum required walkway width and must be of the same material as that of the handrail construction. Kickplates shall be connected to handrail posts as detailed on the drawings.
- H. Expansion joint splices shall be provided at 30 feet maximum spacing and at all expansion joints in the structure supporting the handrail. Material for expansion joint splice shall be the same as railing material.
- I. Where safety chains are required in handrails 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 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.

2.02 FASTENERS

- A. Fasteners when required or specified shall be Type 316 stainless steel.

PART 3 -- EXECUTION

3.01 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work.
- B. Beginning of installation means erector accepts existing conditions.

3.02 PREPARATION

- A. Clean and strip primed items to bare metals where site welding is required.
- B. Supply items required to be cast into concrete with setting templates, to appropriate sections.

3.03 INSTALLATION

- A. Install items plumb and level, accurately fitted, free from distortion or defects.
- B. Provide anchors and plates required for connecting railings to structure.
- C. Aluminum Railings: Aluminum railing fabrication shall be performed by craftsmen experienced in the fabrication of architectural metal work. Exposed surfaces shall be free from defects or other surface blemishes. Dimensions and conditions shall be verified in the field. All joints, junctions, miters and butting sections shall be precision fitted with no gaps occurring between sections, and with all surfaces flush and aligned. Electrolysis protection of materials shall be provided. All dissimilar materials shall be isolated.

3.04 EXPANSION BOLTS

- A. Expansion bolts shall be spaced 10d apart and 6d edge distance (d=diameter of bolt). A safety factor of four shall be provided on expansion bolt pull out values published by the manufacturer.

3.05 ALUMINUM SURFACES

- A. Aluminum surfaces in contact with concrete, grout or dissimilar metals shall be protected with a coat of bitumastic or other approved materials.

- END OF SECTION -

SECTION 05531 - GRATING, FLOOR PLATES AND ACCESS HATCHES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The CONTRACTOR shall furnish, fabricate, and install gratings and floor plates and appurtenances, complete, all in accordance with the requirements of the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 05500 - Metal Fabrications
- B. Painting and protective coating of metalwork and fabricated items shall, unless otherwise specified herein, be performed in accordance with the requirements of Section 09900 entitled "Painting."

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Specifications, codes and standards shall be as specified in Section 05500 entitled "Metal Fabrications" and as referred to herein.

1.04 SUBMITTALS

- A. Submit the following in accordance with Section 01300 entitled "Submittals":
 - 1. Complete fabrication and erection drawings of all gratings, floor plates, access hatches and access doors specified herein.
 - 2. Other submittals as required in accordance with Section 0550 entitled "Metal Fabrications".

PART 2 -- PRODUCTS

2.01 METAL MATERIALS

- A. Metal materials used for gratings, floor plates and hatches shall conform to Section 05010 entitled "Metal Materials", unless noted otherwise.

2.02 METAL FASTENING

- A. All welds and fasteners used for gratings, floor plates and hatches shall conform to Section 05050 entitled "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 materials 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 section of grating shall weigh in excess of 50 lbs. No fasteners shall be permitted to project above the walking surface.
3. Gratings shall be designed for a loading of 150 psf unless a depth is required by the Drawings. Minimum grating depth shall be 1-1/2 inches. Deflection shall not exceed L/240 or 1/4-inch.

B. Aluminum Grating

1. Aluminum grating shall be of I-Bar type with cross bars at 2 inches on center and shall consist of extruded bearing bars positioned and locked by crossbars. All supports, cross members, etc. shall be aluminum. Plank clips for grating holddowns or other required attachments shall be aluminum or stainless steel. Bolts shall be stainless steel.
2. Grating shall be aluminum swage locked "I-Bar" Type IF, as manufactured by IKG Borden or equal.
3. Grating shall be provided with a mill finish.

C. Aluminum Plank Grating

1. Aluminum plank grating shall be unpunched, consisting of 6-inch wide extruded sections, heavy duty type with 6 ribs and plain sides, fabricated in standard sections as manufactured by Ohio Gratings, McNichols, IKG Borden, or approved equal. All planks shall be provided with extruded grating frame cast in concrete.
2. Grating panels shall be made from 6-inch wide extruded sections and banded to form standard panel widths.
3. Removal sections shall be edge banded in sections and provided with stainless steel flush mounted lift handles with necessary plank reinforcing and holdown anchors.
4. Hinged sections shall be shop fabricated ready for field installation. Panels shall be edge banded with a continuous hinge, flush mounted lifting handles (1 section minimum), stainless steel bolts and hardware. Grating frame shall be provided with removable temporary braces to maintain the required opening width during casting. Provide necessary grating reinforcing for lift handles, hinge connections, holdown anchors, etc.
5. Grating shall be provided with a mill finish.

D. Galvanized Steel Grating

1. Galvanized Steel grating shall be custom welded heavy duty steel grating per

ANSI/NAMM MBG 532-000. Minimum bearing bar size shall be 2-1/4" x 1/4". All supports, cross members, etc. shall be galvanized steel. Plank clips for grating hold downs shall be stainless steel. Bolts shall be galvanized steel.

2. All openings shall be banded.
3. Galvanizing shall be in accordance to Section 05035, Galvanizing.
4. Main bearing bars shall conform to ASTM A36. Cross bars shall be flush with the top of the grating.
5. Grating span shall be 36 inches maximum and shall satisfy AASHTO loading for H-20 truck.
6. Grating shall be manufactured by IKG Borden Industries, Leeds, AL.

2.04 CHECKERED PLATES

- A. Checkered plates shall be aluminum alloy 6061-T6, or galvanized steel as indicated on the Drawings. Aluminum checkered plates shall be provided in mill finish, except when otherwise indicated on the Drawings. Checkered plates shall be designed for a live load of 150 pounds per square foot of the gross projected area. The allowable deflection under the above loadings shall be L/240 but not more than 1/4-inch. Minimum thickness shall be 3/8-inch, unless otherwise noted on the Drawings.
- B. Checkered plates shall be standard pattern non-slip of the thickness and sizes on the Drawings. Stiffener angles shall be provided as required to meet the load requirements specified above. All checkered plate sections shall be cut that no one section shall weigh more than 100 pounds.
- C. Flush type lifting handles and hinges and neoprene seals for airtight construction shall be provided where shown on the Drawings.

2.05 ACCESS HATCHES

- 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 show the clear opening requirements.
 2. All doors shall be aluminum (mill finish) unless otherwise noted. All doors in locations subject to direct vehicular traffic shall be galvanized steel designed for H-20 live loads.
 3. Openings larger than 42 inches in either direction shall have double leaf doors.
 4. Doors shall be designed for flush mounting and for easy opening from both inside and outside.

5. All doors shall be provided with an automatic hold-open arm with release handle.
6. Double leaf doors shall be provided with Type 316 stainless steel safety chains 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.
7. 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 Type 316 stainless steel.
8. Cylinder locks with keyway protected by a cover plug shall be provided with all hatches.
9. Door leafs in areas not subject to vehicular traffic shall be 1/4-inch aluminum diamond plate, minimum, stiffened and designed for 300 psf.
10. Door frames shall be trough-type or angle-type as indicated on the Drawings and equipped with a built-in neoprene cushion. On trough-type frames, the drainpipe shall be provided by the CONTRACTOR and shall extend to the nearest point of discharge acceptable to the ENGINEER.
11. Access hatches shall be model indicated on the Drawings by The Bilco Company or equal.
12. Hatches shall be guaranteed against defects for a period of five years.

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. Fabrication shall begin only after such field measurements.
- B. All fabricated work shall be shop fitted together as much as practicable and delivered to the field, complete and ready for erection, unless sections have to be removable. 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 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 05050 entitled "Metal Fastening". All fastenings shall be concealed where practicable.

3.02 INSTALLATION

- A. Assembly and installation of fabricate system components shall be performed in strict accordance with manufacturer's recommendations.
- B. All gratings, access hatches, and access doors shall be erected square, plumb and true, accurately fitted, adequately anchored in place and set at proper elevations and positions.

- END OF SECTION -

DIVISION 6 – WOOD AND PLASTICS

SECTION 06610 - 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 05050, Metal Fastening
- B. Section 07920, Sealants, and Caulking
- C. Section 09900, 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 D2996 – Specification for Filament Wound Reinforced Thermosetting Resin Pipe
 - 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

1.04 SUBMITTALS

- A. The Contractor shall submit shop drawings and a Performance Affidavit for all items specified herein in accordance with Section 01300, Submittals. Shop drawings shall include fabrication details, name of FRP manufacturer, resins, assembly and erection details, sizes of members, profiles, fasteners, supports, anchors, finishes, colors, patterns, clearances, and connections to other work.
- B. Certification of compliance with ASTM Standards.

- C. Where specifically requested, design calculations sealed by a currently Registered Professional Engineer in the State of Florida

1.05 QUALITY ASSURANCE

- A. All fiberglass items of the same type provided shall be the products of a single manufacturer for compatibility.
- B. It shall be the Contractor's responsibility to ensure 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. 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

- A. Fiberglass grating shall be furnished and installed in areas shown on the Drawings including all FRP angle supports, fasteners and accessories. Gratings shall consist of pultruded bearing bars positioned and locked by crossbars. Grating 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 shall be manufactured of polyester resin except for sodium hypochlorite applications where vinyl ester resin shall be used. Grating and treads shall be produced by Strongwell, Fibergate, Inc., Corgrate Fiberglass Systems, 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 supplier shall supply all shelf support angles, embedded angles with anchors, concrete anchors and necessary 316 stainless steel grating clips coated with epoxy paint per Section 09900, Painting, for a complete system.

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 and cages shall be fabricated from pultruded shapes conforming to Extren Series 525 except for sodium hypochlorite applications where Extren Series 625 shall be used. Shapes shall be manufactured by Strongwell, Inc., or equal.
- D. Ladder side rails shall be fabricated from channel members or 2 inch minimum square tube.
- E. Side rails shall be anchored with FRP standoff clips manufactured of polyester resin except for sodium hypochlorite applications where vinyl ester resin shall be used. 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, serrated and covered with a silica grit to produce and 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. Fall prevention system shall be as specified in Section 05515, Ladders.

2.04 CONNECTIONS

- A. All connections shall be non-corrosive, non-staining, and concealed where practicable, as detailed on the Drawings or specified herein.
- B. All fasteners shall be Type 316 stainless steel, except for sodium hypochlorite applications, Hastelloy C-276 shall be used unless noted otherwise.
- C. Holes for bolts and screws shall be drilled.
- D. Joints exposed to water shall be formed to exclude water.

- E. 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 Extren 525 except for sodium hypochlorite applications where Extren 625 shall be used. Shapes shall be manufactured by Strongwell, or equal.
- B. Metal bolted connections shall be made with stainless steel bolts except for sodium hypochlorite applications where Hastelloy C bolts shall be used. Bolts shall conform to Section 05050 entitled "Metal Fastening".
- C. Adhesive bonded connections shall be made with a compatible epoxy adhesive following manufacturer's instructions.

2.06 FRP HANDRAIL

- A. Fiberglass reinforced plastic (FRP) handrail system shall be designed by the Contractor to meet or exceed OSHA requirements with a minimum safety factor equal to 2, and shall be furnished and installed as shown on the Contract Drawings. All rails, posts, kick plates, base plates, fasteners, and necessary appurtenances for a complete and rigid installation shall be provided and installed per manufacturer's recommendations. Handrail systems shall be manufactured by Strongwell, Inc., Bristol, VA, R.W. Fowler Company, Atlantic Beach, FL, IMCO Reinforced Plastics, Inc., Moorestown, NJ, or equal.
- B. The handrail system shall consist of pultruded fiberglass shapes manufactured with the following minimum properties:

Properties	Test Method	Value
Tensile Stress	ASTM D638	30,000 psi
Tensile Modulus	ASTM D638	2.5 x 10 ⁶ psi
Compressive Strength	ASTM D695	30,000 psi
Compressive Modulus	ASTM D695	2.5 x 10 ⁶ psi
Flexural Stress	ASTM D790	30,000 psi
Flexural Modulus	ASTM D790	2.0 x 10 ⁶ psi
Shear Stress	ASTM D2344	4,500 psi
Density	ASTM D792	.070 lbs/in ³
24 hr. Water Absorption	ASTM D570	0.6% max
Coeff. of Thermal Expansion	ASTM D696	6 x 10 ⁶ in/in/EF
Barcol Hardness	ASTM D2583	50

- C. The handrail system shall have two (2) rails, unless otherwise noted on the Contract Drawings, with the top rail located 42 inches above the walking surface. Rails and posts shall be 2" square tubing with internal fittings for all connections. Kick plates shall be

provided where required by OSHA. All rail and kick plate corner joints shall be mitered at a 45° angle and securely fastened to posts. Maximum horizontal spacing between posts shall be 4 feet. For stair rail, the top rail shall be not less than 34 inches nor more than 38 inches above the leading edge of the stair tread.

- D. Handrails shall be erected with true horizontal and vertical alignment and shall be smooth and free of surface defects. All cut edges and holes shall be sealed with a compatible resin system.

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 first class.

3.02 HANDLING, TRANSPORTING, AND STORING

- A. All FRP items shall be properly packed, labeled and stored in accordance with Divisions 1 and 11, and where 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 -

DIVISION 7 – THERMAL AND MOISTURE PROTECTION

SECTION 07190 - VAPOR BARRIER

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The CONTRACTOR shall furnish and install a vapor barrier to be placed under all reinforced concrete placed against soil as specified herein or shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 03300 – Cast-in-Place Concrete

PART 2 -- PRODUCTS

2.01 VAPOR BARRIER

- A. The vapor barrier shall be 10 mil thick polyethylene sheet meeting the requirements of ASTM E 1745 Class A.

- 1. Minimum tensile strength ASTM E154: 52 pounds per inch
- 2. Puncture resistance ASTM D1709, Method B: 2600 grams
- 3. Maximum permeance ASTM E96: 0.036 U.S. perms

- B. Vapor barrier shall be Vaporblock 10 by Reven Industries, Perminator 10 mil by W.R. Meadows, Florprufe 120 by Grace Construction Products, or approved equal.

2.02 ADHESIVE OR TAPE

- A. Adhesive or tape for joining sheets shall be approved by the manufacturer of the vapor barrier material.

PART 3 -- EXECUTION

3.01 VAPOR BARRIER

- A. Vapor barrier shall be placed under all concrete contacting soil; or stone, lap edges 12 inches and seal with adhesive tape. Barrier shall be laid with seams perpendicular to and lapped in the direction of pour. No screed supports or other items shall be allowed to penetrate vapor barrier.
- B. Application shall be protected from damage until concrete is placed. Punctures and tears in vapor barrier shall be repaired using patches of the material which overlaps puncture or tear a minimum of 12 inches; seal with tape or adhesive.
- C. Fill under vapor barrier shall be compacted, clean and free of debris and protrusions.

END OF SECTION -

SECTION 07510 – BUILT-UP BITUMINOUS ROOFING

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish and install 20-year guaranteed built-up roofing systems and all appurtenant work, complete, and shall coordinate all of the work hereunder with the related work specified in other Sections, all in accordance with the requirements of the Contract Documents. The new built-up roofing shall be installed on the roof of the RAS Pump Station No. 1.
- B. The Contractor shall retain the services of a licensed roofing contractor who shall inspect the work, prepare and submit the specified submittals to the Engineer for review. Upon acceptance by the Engineer, the roofing contractor shall apply for and secure a roofing permit from the City of Hollywood's Building Department. The Contractor shall prepare and submit all documentation as required by the Building Department for a roofing permit. During the roofing contractor's inspections, changes may be required to the shown roofing layouts, accessories and drainage; such changes shall be documented in the submittals and performed at no additional costs to the Contract.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 07600 - Flashing and Roofing Accessories

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Federal Specifications

- 1. SS-A-701B Asphalt, Petroleum (Primer, Roofing, and Weatherproofing).
- 2. SS-C-153C Cement, Bituminous, Plastic.

B. Commercial Standards

- 1. ASTM D 41 Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing.
- 2. ASTM D 226 Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.
- 3. ASTM D 249 Specification for Asphalt Roll Roofing (Organic Felt) Surfaced with Mineral Granules.
- 4. ASTM D 250 Specification for Asphalt-Saturated Asbestos Felt Used in Roofing and Waterproofing.
- 5. ASTM D 312 Specification for Asphalt Used in Roofing.

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| 6. | ASTM D 1668 | Specification for Glass Fabrics (Woven and Treated) for Roofing and Waterproofing. |
| 7. | ASTM D 1863 | Specification for Mineral Aggregate Used on Built-up Roofs. |
| 8. | ASTM D 1866 | Test Method for Translucency of Mineral Aggregate Used on Built-Up Roofs. |
| 9. | ASTM D 2178 | Specification for Asphalt Glass Felt Used in Roofing and Waterproofing. |
| 10. | ASTM D 2626 | Specification for Asphalt-Saturated and Coated Organic Felt Base Sheet Used in Roofing. |
| 11. | FM | Factory Mutual. |
| 12. | U/L | Underwriters Laboratories, Inc. |
| 13. | FS HH I 1972/GEN | Insulation Board, Thermal, Faced, Polyurethane or Polyisocyanurate |

C. Trade Standards

- | | | |
|----|------|---|
| 1. | NRCA | National Roofing Contractors Association. |
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D. Manufacturer's Standards

1. In addition to the standards listed above, the roofing products and their installation shall be in accordance with the manufacturer's published recommendations and specifications.

1.04 SUBMITTALS

- A. Submittals shall be in accordance with the requirements of Section 01300 entitled "Submittals".
- B. Plan layouts of the proposed roofing (minimum scale shall be 1/8 inch = 1 foot) shall be submitted. The layout shall identify the complete scope of work, details of parapet flashings, equipment support area details, pipe and other roofing penetration details as required for a complete installation. The Contractor shall coordinate all dimensions associated with roof-mounted equipment and identify them on the roofing layout.
- C. The manufacturer's specifications, literature, and published installation instructions for each major roofing element, product or system shall be submitted to the Engineer. Shop drawings showing sizes, shapes, thickness, types of materials, finishes, fabrication details, anchors, connections, expansion joints and installation instructions shall be provided at large scale on full size drawings. Provide samples of each product and color samples of cap sheet.
- D. Miami-Dade Product Approval for use in the High Velocity Hurricane Zone.

- E. Roofing shall be applied by a roofing contractor, approved by the Contractor, through the roofing manufacturer, in writing, with a copy of such approval submitted to the Engineer.
- F. A certification from the manufacturer that the proposed roofing flashing and accessories are covered by the manufacturer's 20 year system warranty.
- G. After installation of the roofing, the Contractor shall furnish to the Engineer a signed affidavit that the roof complies with the requirements of these Specifications and the manufacturer's recommendations for the class and type of roof specified.
- H. The Contractor shall furnish the Engineer with duplicate signed copies of the Roof Guarantee as specified in Section 01300 entitled "Submittals". A sample copy of the guarantee, on the form that will be used for the actual guarantee, shall be submitted with the shop drawings, for review.

1.05 ENVIRONMENTAL REQUIREMENTS

- A. Do not apply roofing membrane during inclement weather.
- B. Do not apply roofing membrane to damp or frozen deck surfaces.
- C. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed during the same day.
- D. At lower air temperatures, to assure sound adhesion, care must be exercised to provide asphalt, at the point of application, at the asphalt's equiviscous temperature (EVT) plus 20 degrees Fahrenheit or at 400 degrees Fahrenheit, whichever is higher.

1.06 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Manufactured materials shall be delivered in original, unbroken packages, containers, or bundles bearing the name of the manufacturer.
- B. All materials shall be carefully stored in a manner that will prevent damage of the products and in an area that is protected from the elements.

1.07 QUALITY ASSURANCE

- A. The Contractor shall pay the cost of all test cutting, testing, and repairs. If deviations from written and accepted manufacturer's specifications are found, the Contractor, at its own expense, shall make all corrections necessary to meet the requirements of the Contract Documents, the roofing manufacturer recommendations, and the requirements of the Engineer.
- B. The Contractor shall provide a minimum of three site visit inspections by an official manufacturer's representative on all roofing and flashing. Inspections are to be made at the beginning of the job and a minimum of once more while the roofing and/or flashing work is in progress to ensure workmanship is in accordance with the manufacturer's specifications.
- C. The Contractor is cautioned that the products specified in these specifications may require the purchase of a minimum quantity from the manufacturer. The minimum purchase

quantities may exceed the quantities defined in the Contract Documents. The Owner or the Engineer will not consider requests for substitutions of specified products unless equal in physical and performance characteristics and accompanied with appropriate credits. The responsibility of providing quantities required shall remain with the Contractor.

1.08 TESTING

- A. The Contractor shall retain the services of a testing company to perform testing of the built-up bitumen roofing installed under this Contract.
- B. The testing program performed by the testing company will include an infrared imaging test (performed at night) of the roofing membrane and insulation to detect leaks in the system. The test will be conducted in accordance with ASTM C 1153 by a Level III inspector certified by the American Society of Nondestructive Testing, Inc.
- C. The roofing system will not be accepted by the Owner should the testing company detect any leaks in the system. If moisture is detected in the insulation of the substrate, repairs shall be performed by the Contractor at no additional costs to the Owner. Repairs shall be acceptable to the roofing manufacturer to satisfy the specified guarantee requirements. After repairs are performed, the roofing shall be re-tested by the testing company. The Contractor shall be responsible for the re-testing costs.
- D. If the re-tests detect further moisture in the system, then the entire roofing system shall be removed and replaced by the Contractor at its expense.

1.09 GUARANTEE

- A. A manufacturer's "No-Dollar-Limit" Guarantee for a period of 20 years is required for all new roofing applications under this Contract. The Contractor shall engage the services of a roofing contractor approved by the manufacturer to install the roofing system subject to the guarantee requirements specified herein. The roofing contractor shall provide the manufacturer with all necessary documentation to ensure the provision of the guarantee. The sources of bitumen shall be acceptable to the roofing manufacturer.
- B. All roofing accessories, including flashing, fasteners, roof vents, curb details and other miscellaneous metals and accessories required for the installation shall be supplied by the roofing manufacturer or from other sources acceptable to the manufacturer selected for the installation so that the system guarantee will include all edges, penetrations and other details of the installation.
- C. The system guarantee shall promise that for the period of the guarantee, the manufacturer will pay for repairs to stop leaks resulting from natural deterioration of the membranes or poor workmanship in applying the roofing materials or failure of the system to perform as roofing and providing a waterproof, watertight system.

1.10 SERVICES OF MANUFACTURER'S REPRESENTATIVE

- A. Inspection and testing will be performed by a Professional Engineering firm or manufacturer's representative approved by the Engineer.
- B. Correct defects and irregularities reported.

1.11 MANUFACTURERS

- A. The built-up roofing system shall be as manufactured by Johns Manville, The Garland Company, Tremco Roofing or equal.

PART 2 – PRODUCTS

2.01 ROOFING SYSTEM

- A. The roofing system shall be a five ply mineral surfaced fiberglass built up roof over the specified tapered rigid insulation. The system shall be 5GIC by Johns Manville or equal.

2.02 ROOF INSULATION

- A. The roof insulation shall consist of 1 inch thick rigid roof insulation boards. The boards shall be comprised of a closed cell Polyisocyanurate foam core bonded to fiberglass reinforced facers. The minimum R-value of insulation, when tested in accordance with ASTM C1289, shall be 5.7 (hr-ft²-F)/BTU per inch of thickness. ENRGY 3 by Johns Manville meets the requirements of these Specifications.

2.03 ASPHALT

- A. Asphalt shall meet the requirements of ASTM D 312, Type III. The sources shall be approved by the roofing manufacturer for the purpose of the guarantee.

2.04 ROOF FELTS

- A. Roof felts shall be approved by the manufacturer for a 20-year no dollar limit roofing guarantee. Roof felts shall comply with ASTM D 2178, Type VI. Roof felts shall be type G-1 coated ply sheets as classified by Underwriters Laboratories. Glas Ply Premier by Johns Manville meets the requirements of this Section.

2.05 CAP SHEET

- A. The cap sheet shall be a mineral surfaced, asphalt coated, fiberglass cap sheet for use in hot applied built-up roofing systems. The cap sheet shall be classified as a Type G-2 Coated Cap sheet by Underwriter's Laboratories, and shall meet the requirements of ASTM D 3909. GlasKap by Johns Manville meets the requirements of this section.

2.06 ROOFING ACCESSORIES

- A. Roofing Accessories are specified in Section 07600 entitled "Flashing and Roofing Accessories".

PART 3 – EXECUTION

3.01 SHIPPING, HANDLING AND STORAGE

- A. Deliver roofing materials to the job site in manufacturer's original unopened packing with seals intact. Store materials off the ground and under cover. Store roof goods on end.

Handle materials to avoid damage or contamination. Protect building and adjacent areas from bitumen spillage and repair or replace damage at no additional cost to the Owner.

3.02 JOB CONDITIONS

- A. Surfaces to which roofing is to be applied shall be smooth, even, sound, thoroughly clean and dry and free of defects which would adversely affect application of this work. Surfaces which do not meet the tolerances imposed within the sections governing their installation or which contain defects shall be repaired or replaced prior to installation of this work. Application of the roofing will be considered acceptance of the roof deck and approval by the Contractor as an acceptable base for roofing.
- B. Coordinate with sheet metal, plumbing, electrical, HVAC and mechanical subcontractors to insure all roofing penetrations are in place prior to commencement of work.
- C. Proceed with the roofing and associated work only when existing and forecasted weather conditions will permit the work to be performed as scheduled.
- D. Prior to commencement of installation of the roofing, a pre-roofing conference is to be held by the Contractor. The Contractor, Roofing Contractor, Engineer, Owner's representative and the Roofing Manufacturer Representative shall be present to discuss any and all details, procedures and schedules.

3.03 GENERAL ROOFING INSTALLATION

- A. Fabricate and install the built-up roofing system described herein in accordance with the roofing manufacturer's requirements.
- B. Install insulation board to roofing in accordance with manufacturer recommendations for the appropriate roof deck. All seams shall be taped. Bends and covers shall be cut to fit snug.
- C. Cant strips and tapered edge strips shall be provided at all intersections of roof surfaces with vertical walls, parapets, curbs, and accessories which do not have built-in cants, and shall be miter cut at corners. Cant strips and tapered edge strips shall be firmly attached in place prior to roof application.
- D. Heat and apply asphalt to the roofing surface at temperatures recommended by the roofing manufacturer using apparatus capable of providing controlled temperatures. Asphalt which has been burned shall be discarded. Apply asphalt evenly, leaving no bare spots at a rate of 20 pounds per 100 square feet. Lap piles 4-inches at edge and 6-inches at ends. Embed cap sheet and lapped edges and ends in full hot application as steep asphalt. Nail through laps and along center of cap sheet; stagger nails. Broom in each ply to complete embedment. Solid mop heated bitumen under and between felts. Provide complete uniform coating. Felt shall not touch felt. Lay felts parallel to long dimension of roof. Broom or press felts into heated bitumen providing tight, smooth lamination without wrinkles, buckles, kinks, fishmounts, pockets, or busters.
- E. Flashing and all other connections of roofing with other work shall be completed before the application of the finishing surface. Bed all metal base flashings, gravel stops and similar items in roofing cement or bitumen after all felts are in place. Base flashings and

gravel stops shall be stripped with two piles of roofing felt over the metal and embedded in roofing cement.

- F. Coordinate work with sheet metal and the work of other trades. Finish areas as rapidly as practicable after completion of the other work. Incomplete roofing shall be protected from dampness by a light coat of asphalt when final coating is delayed.

3.04 ROOFING

- A. Install a complete 20-year guaranteed roof fully complying with the specifications and recommendations of the roofing manufacturer.
- B. At all edges and similar locations where seepage of bitumen is possible, the bitumen shall be applied to within 4-inches of such edge or location and this 4-inches is to be coated with a heavy layer of roof cement or asphalt, into which the felt is to be embedded.

3.05 SHEET METAL

- A. Coordinate flashing and trim work with the installation of roofing, waterproofing, piping, existing building, and other adjoining and substrate work. Sheet metal shall be painted aluminum as specified in Section 07600.

3.06 PROTECTION AND CLEANING

- A. The Contractor shall protect the work of other trades. Work damaged by an operation under this section shall be repaired or replaced at no expense to the Owner. All soiled adjoining surfaces shall be carefully cleaned. All debris and surplus material resulting from work under this section shall be removed from the premises.

- END OF SECTION -

SECTION 07600 - FLASHING AND ROOFING ACCESSORIES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The CONTRACTOR shall furnish and install roofing sheet metal work and related items necessary for a complete installation, as indicated on the Drawings and specified herein, including, but not limited to the following: base flashings; pitch pans, scuppers, and other sheet metal work in conjunction with roof drainage; pipe and stack flashings, and similar items where furnished by equipment suppliers; flashings for ducts, exhaust piping, equipment piping, conduit, etc., penetrating roofing that may be required.

1.02 SUBMITTALS

- A. Submit shop drawings and samples for review in accordance with Section 01300 entitled "Submittals". Provide sizes, shapes, thicknesses and types of materials, finishes fabrication details, anchors, connections and expansion joints in relation to adjacent work.
- B. Submit a 12-inch square sample of wall flashing, angle clamping bar and other metal work specified. Deliver samples to a field location as directed by the Engineer.

1.03 APPLICABLE STANDARDS

- A. Except as otherwise shown or specified, comply with applicable manual by (SMACNA) Sheet Metal and A/C Contractors National Association.
- B. Except as otherwise shown or specified, comply with the recommendations and instructions of the manufacturer of the sheet metal being installed.
- C. All materials and installation shall conform to or exceed the requirement of all local codes.

1.04 GUARANTEE

- A. The roofing guarantee specified in Section 07600 entitled "Built-up Bituminous Roofing" shall cover flashings and accessories specified in this section. The flashing and edge details shall be as required by the roofing manufacturer to satisfy conditions of the guarantee. The details shown on the Drawings are intended to provide minimum standards required for the guarantee.

PART 2 -- PRODUCTS

2.01 FLASHING

- A. Flashing and other cover plates shall be Presto Lock Fascia System by Johns Manville, or equal. Provide a full strength Kynar 500 paint finish with a 20 year warranty. Color shall match existing.

2.02 CANT STRIPS

- A. Cant Strips shall be Fes-Cant Plus Cant Strip or Tapered Edge Strip by Johns Manville or equal. The strips shall be a high density; laminated board made of high strength fibers and expanded perlites. Cant strips shall be approved by the roofing system manufacturer and shall comply with the requirements of the full system guarantee and the Product Approval.

2.03 ROOF VENTS

- A. Roof vents shall be provided for all roofing applications. One vent per 1000 square feet of applications shall be provided. One vent per 1000 square feet of roofing area shall be provided. The vents roofing area shall be provided. The vents shall be FP-10 One Way Roof Vents by Johns Manville or equal.

2.04 PLASTIC CEMENT

- A. Plastic cement shall conform to ASTM D 2822.

2.05 FASTENERS

- A. Nails, bolts, nuts, screws, washers, etc., shall be No. 410 stainless steel.

2.06 ANCHORS

- A. Anchors for fastening items to concrete shall be stainless steel machine screws or bolts and Rawl plug inserts of Phillips Red Head concrete anchors of the size and type noted or required.

2.07 BITUMINOUS PLASTIC CEMENT

- A. Bituminous plastic cement shall conform to FS SS-C-153.

2.08 ASPHALTIC MATERIAL

- A. Asphalt primers shall conform to FS S-A-701. Coating asphalt shall have brushing consistency conforming to FS SS-R-451.

2.09 SCUPPERS AND DOWNSPOUTS

- A. Scuppers and Downspouts shall be 0.04-inch aluminum with Kynar 500 finish. Color will be selected by the Engineer to match existing.

2.10 PARAPET COPING

- A. Coping cover plates, anchor clips, splice plates and accessories shall be Presto Lock Coping System by Johns Manville or equal. Provide a full strength Kynar 500 paint finish with a 20 year warranty. Color shall match existing.

2.11 ROOF WALKWAY PADS

- A. Walkway pads shall be preformed, skid resistant, 32-inch x 32-inch, with a minimum thickness of 3/8-inch, approved by the roofing system manufacturer to comply with the full

system guarantee. Dynatred plus roof walkway by Johns Manville complies with the requirements of this section.

PART 3 -- EXECUTION

3.01 SHIPPING, HANDLING AND STORAGE

- A. Store materials off the ground to avoid damage. Protect from bitumen spillage and repair or replace damage at no additional cost to the CITY.

3.02 JOB CONDITIONS

- A. Coordination: Coordinate with the roofing system, sheet metal, plumbing, electrical, HVAC and mechanical subcontractors to insure that all items are in place prior to commencement of work.
- B. Climatic Conditions: Proceed with the roofing and associated work only when existing and forecasted weather conditions will permit the work to be performed as scheduled.

3.03 SHEET METAL INSTALLATION

- A. General: Coordinate metal flashing and trim work with the installation of roofing, waterproofing, piping, existing building, and other adjoining and substrate work. Surfaces to be coated shall be smooth and clean. The installer must examine the substrate and the conditions under which the metal flashing will be installed, and notify the CONTRACTOR in writing of any unsatisfactory conditions. Do not proceed with installation until unsatisfactory conditions have been corrected in a manner acceptable to the installer. Flanges or gravel stops, vent and other flashings, shall be bedded in hot asphalt, set on top of the roofing plies and reinforced with felt strips as specified. Work shall be water tight, with lines, arises and angles sharp and true. Surfaces shall be free from waves and buckles.
- B. Fabrication: Fabricate and install work described herein in accordance with the applicable standard described and illustrated in the National Association, Inc. publication "Architectural Sheet Metal Manual".
- C. Flashings: Base and all other flashings shall be watertight and of a bondable type.
- D. Scuppers: Scuppers and the like, shall be fabricated as indicated on the Drawings, or equal, and properly installed.
- E. Accuracy: Fabricate and install work with lines and corners of exposed units true and accurate. Form exposed faces flat and free from buckles, excessive waves and avoidable tool marks, considering the temper and reflectivity of the metal. Provide uniform, neat seams with minimum exposure of solder welds, and sealant. Except as otherwise shown, fold back the sheet metal to form a hem on the concealed side of exposed edges.
- F. Fasteners: Conceal fasteners and expansion provisions wherever possible in exposed work, and locate so as to minimize the possibility of leakage. Cover and seal work as required for a tight installation. Fasten sheet metal items as indicated or required to provide

rigid, secure installation free of warp. Fastenings shall be made in such a manner as not to impair the watertight integrity of the installation. Exposed face nailing will not be permitted.

- G. Laps: For embedment of metal flanges in roofing or composition flashing or stripping, extend flanges for a minimum of 4-inch embedment. Lap seams of sheet metal in direction of flow. Single lock flat seams, heliarc weld or double-lock and mallet flat. Lap seams occurring in members sloping 45 degrees or greater shall be lapped 4-inch minimum and be bedded in flashing cement. Provide loose-locked expansion joints a maximum of 20 feet and a minimum of 8 feet from corners. On vertical surfaces, lap 2 piece flashings a minimum of 3 inches.
- H. Protection: Separate dissimilar metals from each other by painting each metal surface in the area of contact with a heavy application of bituminous coating, or by other permanent separation as recommended by the manufacturers of the dissimilar metals. The flashing subcontractor shall advise the CONTRACTOR of required procedures for protection of the completed flashing and trim. Furnish such advice for period of installation of other work, and also for the remainder of the construction period.

3.04 COORDINATION

- A. Coordinate flashing work with the work of other trades. Adjacent work shall be kept clean and shall not be injured or defaced in any way.

3.05 PROTECTION AND CLEANING

- A. The CONTRACTOR shall protect the work of other trades. Work damaged by an operation under this section shall be repaired or replaced at no expense to the CITY. All soiled adjoining surfaces shall be carefully cleaned.
- B. All debris and surplus material resulting from work under this section shall be removed from the premises.

- END OF SECTION -

SECTION 07920 - SEALANTS AND CAULKING

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall provide sealant and caulking work required for a complete installation as is indicated on the Drawings and specified herein. The required applications of sealants and caulking include, but are not necessarily limited to, the following general locations:
 - 1. Masonry joints, exterior and interior.
 - 2. Joints at penetrations of walls, decks by piping, doors, windows, louvers and other services and equipment.
 - 3. Joints between items of equipment and other construction.
 - 4. Joints in concrete.

1.02 SUBMITTALS

- A. Submit shop drawings and color samples of sealant for review in accordance with the Section entitled "Submittals".
- B. Submit a two year guarantee on sealant type caulking work against joint failure. Joint failure is defined as leaks of air or water; evidence of loss of cohesion; fading of sealant material; migration of sealant; evidence of loss of adhesion between sealant and joint edge.

1.03 ACCEPTABLE MANUFACTURERS

- A. The following list of manufacturer products are acceptable for this Section, subject to conformance with the specified requirements: Tremco, Thiokol, Dymoric, Sika Corporation or equal.

PART 2 -- PRODUCTS

2.01 MATERIALS

- A. Primer: Where required by sealant manufacturer, the primer shall be a compound designed to insure the adhesion of sealant. Material shall be provided by the sealant manufacturer and shall be selected for compatibility with substrate.
- B. Sealant
 - 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 50% in extension or compression such as Sikaflex-2C NS/SL, Sika Corporation, or approved equal.
 - 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 or approved equal.
 - 3. Type 3: Single component, low-modulus moisture curing silicone meeting ASTM C-920, Type S, Grade NS, Class 25, Use NT, M, G, and A. Capable of withstanding 50% extension and compression. Pecora 890 by Pecora Corporation, or approved equal.

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, or approved equal.
 5. Type 5: Single component, acrylic latex meeting ASTM C-834. AC-20+ Silicone by Pecora Corporation, or approved equal.
 6. Type 6: High grade butyl sealant meeting Federal Specification TT-S-00-1657. BC-158 by Pecora Corporation or approved equal.
 7. Type 7: Multi-component chemical resistant polysulfide sealant conforming to ASTM C-920, Type M, Grade NS, Class 25 such as Sonolastic Two Part by BASF Construction Chemicals, or approved equal.
 8. Type 8: Non-sag, Multi Component, traffic grade polyurethane sealant meeting ASTM C-920, Type 19, Grade NS, Class 25, use T, M, A, and O. DynaTread by Pecora Corporation or approved equal.
- C. Joint Backing shall be closed cell foam. Material shall be nonreactive with caulking materials and non-oily. Minimum density shall be 3.24 pcf. Use no asphalt or bitumen-impregnated fiber with sealants.
 - D. Joint cleaner shall be as recommended by sealant or caulking compound manufacturer.
 - E. Joint Primer shall be as recommended by sealant manufacturer.
 - F. Bond Breaker tape shall be either polyethylene or plastic as recommended by the sealant manufacturer.
 - G. Color: Where manufacturer's standard colors do not closely match materials being sealed, provide a custom color.

PART 3 -- EXECUTION

3.01 GENERAL

- A. Comply with sealant manufacturer's printed instructions except where more stringent requirements are shown or specified and except where manufacturer's technical representative directs otherwise.

3.02 SHIPPING, HANDLING AND STORAGE

- A. Store and handle materials so as to prevent the inclusion of foreign matter or the damage of materials by water or breakage. Procure and store in original containers until ready for use. Material showing evidence of damage will be rejected.
- B. Store and handle materials so as to prevent the inclusion of foreign matter or the damage of materials by water or breakage. Procure and store in original containers until ready for use. Material showing evidence of damage shall be rejected.

3.03 INSTALLATION

- A. Employ only proven installation techniques, which will insure that sealants will be deposited in uniform, continuous ribbons without gaps or air pockets, with complete "wetting" of the joint bond surface equally on opposite sides. Except as otherwise indicated, the Contractor shall fill the sealant rabbet to a concave surface, slightly below adjoining surfaces. Where horizontal joints are between a horizontal surface and a vertical surface, fill joint to form a slight cove, so that joint will not trap moisture and dirt.
- B. Install sealants to depths as specified, or if not, as recommended by the sealant manufacturer and as follows:

1. Moving Joints: For normal moving joints sealed with elastomeric sealants but not subject to traffic, fill joints to a depth equal to 50% of joint width, but not more than 1/2-inch deep or less than 1/4-inch deep.
2. Sealed Joints: For joints sealed with non-elastomeric sealants and caulking compounds, fill joints to a depth in the range of 75% to 125% of joint width.
3. Thresholds: Set thresholds in full bed of caulking compound; remove excess materials.

3.04 SCHEDULE

Schedule of Sealants

Application	Sealant	Color
Vertical and horizontal joints bordered on both sides by concrete, masonry, precast concrete or other porous building material.	Type 2	To closely match adjacent surfaces or mortar and as selected by the City.
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 City.
Masonry expansion and control joints less than 1¼" wide.	Type 2	To closely match adjacent surfaces and as selected by the City.
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 City.
Perimeter sealing of doors, windows, louvers, piping, ducts, and electrical conduit. See Note 1.	Type 2 OR Type 3	To closely match adjacent surfaces and as selected by the City.
Below thresholds.	Type 6	Manufacturer's standard
Submerged in liquids. See Notes 2 and 3.	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.
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 City.

Note 1. Provide UL approved sealants for penetrations thru fire-rated walls and as specified in Section 07270.

Note 2. Sealants which will come in contact with potable water shall meet the requirements of NSF 61.

Note 3. Where sealant will be immersed in liquid chemicals verify compatibility prior to installation of sealant.

3.05 PROTECTION OF ADJOINING SURFACES

- A. Prime or seal the joint surfaces wherever shown or recommended by the sealant

manufacturer. Do not allow primer/sealer to spill or migrate onto adjoining surfaces.

3.06 SEALANT BACKER ROD

- A. Install sealant backer rod for liquid elastomeric sealants, except where shown to be omitted or recommended to be omitted by sealant manufacturer for the application shown.

3.07 BOND BREAKER

- A. Install bond breaker tape wherever shown and wherever required by manufacturer's recommendations to insure that elastomeric sealants will perform properly.

3.08 SPILLAGE

- A. Sealants or compounds shall not overflow or spill onto adjoining surfaces, or to migrate into the voids of adjoining surfaces. Masking tape or other precautionary devices shall be used to prevent staining of adjoining surfaces.

3.09 CURING

- A. Sealants and caulking compounds shall be cured in compliance with manufacturer's instructions and recommendations, to obtain high early bond strength, internal cohesive strength, and surface durability.

3.10 CLEANING

- A. Excess and spillage of compounds shall be promptly removed as the work progresses. Adjoining surfaces shall be cleaned by whatever means may be necessary to eliminate evidence of spillage. Do not damage the adjoining surfaces or finishes.

- END OF SECTION -

DIVISION 8 – DOORS AND WINDOWS

SECTION 08110 - STEEL DOORS AND FRAMES

PART 1 - GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish and install steel doors and frames as specified herein and as required for a complete installation.

1.02 MANUFACTURERS

- A. The steel doors and frames shall be as manufactured by Curries, Ceco, Ingersoll Rand, or approved equal.

1.03 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 08710 – Finish Hardware
- B. Section 09900 – Painting

1.04 REFERENCES

- A. Florida Building Code
- B. UL 10B – Fire Tests of Door Assemblies
- C. ASTM A366 – Specification for Steel, Sheet, Carbon, Cold-Rolled, Commercial Quality.
- D. NFPA 80 – Standard for Fire Doors and Windows
- E. NFPA 101 – Life Safety Code
- F. U.L. – Underwriter's Laboratories
- G. WHI – Warnock Hersey International, Division of Inchcape Testing Services
- H. ANSI/DHI A115- Series Specifications for Steel Door and Frame Preparation for Hardware
- I. ANSI/SDI 100- Recommended Specifications: Standard Steel Doors and Frames
- J. ASTM A153- Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
- K. ASTM A366/A 366M- Standard Specification for Steel, Sheet, Carbon, Cold-Rolled Commercial Quality
- L. ASTM A525- Standard Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process.
- M. ASTM E152- Standard Methods of Fire Tests of Door Assemblies

1.05 SUBMITTALS

- A. The Contractor shall submit complete shop drawings to the Engineer for review in accordance with Section 01300 entitled "Submittals". Shop drawings shall indicate dimensions, elevations, construction details, assembly methods, hardware reinforcement and locations, gauges, finish, wall conditions and building location.
- B. The submittal shall include the following:
 - 1. Product cut sheets for frames, anchors, door panels and all finish hardware.
 - 2. A complete door schedule indicating the masonry openings versus the proposed doors, doorframes and the associated door hardware. Prior to the submittal, all door openings shall be field-verified by the Contractor.
 - 3. A complete hardware schedule conforming to Section 08710 entitled "Finish Hardware", in compliance with product approval. Hardware schedule shall be submitted concurrent with door shop drawing.
 - 4. Installation details, edge distances, material, size, and spacing of anchorage.
 - 5. Locking arrangement.
 - 6. Sealants.
 - 7. Miami-Dade County Notice of Approval or a Florida Department of Community Affairs Product Approval for use in High Velocity Hurricane Zones, current at the time of submittal.
 - 8. The Engineer will review and return the submittals to the Contractor. The Contractor shall then submit the accepted package to the Building Department having jurisdiction over the work for approval. No fabrication or installation shall begin until the Building Department approval is obtained by the Contractor. The Owner will not assume responsibility for any cost or schedule impacts due to the approval process of the Building Department. It is the Contractor's responsibility to customize the submittals based on the Building Department's published submittal processes.

1.06 DELIVERY, STORAGE AND HANDLING

- A. The Contractor shall deliver, store, and handle doors and frames in a manner to prevent damage and deformation. Store on pallets at the job site and undercover to form weather tight enclosure. Spacers shall be provided between doors and frames to prevent metal-to-metal contact.

PART 2 -- PRODUCTS

2.01 STEEL DOORS

- A. The Contractor shall provide doors and frames from the same Manufacturer. All doors shall be of flush steel construction and 1-3/4 inch thick. Flush doors shall be constructed

of two outer layers of ASTM A366 steel over steel stiffeners and filled with core material as follows:

1. Non Fire-Rated Doors: Polystyrene foam core, self extinguishing, non-toxic in case of fire.
 2. Fire-Rated Doors: Mineral Fiber Core sufficient to obtain a 250 degree Fahrenheit temperature rating.
- A. Both lock and hinge rail edge of the door shall be welded, filled and ground smooth the full height of the door. Lock rail shall be one-piece full height 12-gauge pressed channel. Hinge rail shall be one-piece full height 12-gauge pressed channel, formed and tapped for hinges. Top and bottom of door shall have 12-gauge steel closure channels.
- B. Minimum gauges for exterior face sheets of door shall be as follows:
1. Exterior Door: 16 Gauge
 2. Interior Door: 18 Gauge
 3. Interior Fire Rated Door: 16 Gauge
- C. Prepare doors to receive finish hardware per approved schedule.

2.01 STEEL DOOR FRAMES

- A. Steel doorframes shall be fabricated of 16-gauge cold rolled steel in accordance with ASTM A366. After fabrication frames shall be primed with light gray rust inhibitive primer. Paint color finish shall be selected by the Engineer at the time of the shop drawing submittal.
- B. Standard floor knee shall be provided for anchorage to floor.
- C. Three sided frames shall have angle spreaders secured to bottom of frame for rigidity during shipment.
- D. Frame corners shall be internally reinforced, welded and ground smooth. Adequate reinforcement shall be provided for all hardware, drilled and tapped for field application. Dust clogging of tapped holes by mortar or plaster. Reinforcement shall also be provided for surface applied hardware for which drilling and tapping is done in the field. After fabrication, frame shall be degraded and then prime coated.
- E. Punch single leaf frames to receive three silencers on lock jamb. Punch double leaf frames to receive one silencer at each leaf in head members.

2.02 ANCHORS

- A. For cast-in-place concrete or existing door openings, anchor frame jambs with 3/8" minimum counter-sunk bolts into expansion shield or inserts, with crush-proof sleeves. Provide a minimum of two per jamb. Anchors shall be in accordance with product approval.

2.03 FINISHES

- A. Doors shall be field painted per Section 09900 entitled "Painting".

PART 3 -- EXECUTION

3.01 FRAME INSTALLATION

- A Frames shall be installed plumb, level, and true to line, rigidly secured in openings. Frames shall be installed in strict accordance with the tested prototype assembly details.
- B Frames in new masonry walls shall be set prior to beginning masonry work. Brace frames until permanent anchors are set. Frames shall be filled with masonry grout as masonry work progresses. Anchors shall be provided in accordance with SDI standards.
- C Frames in existing masonry walls shall be installed using countersunk bolts and expansion shields.

3.02 DOOR INSTALLATION

- A Doors shall be installed plumb, level and true to line. Hardware shall be applied and adjusted to achieve quiet and smooth operation. Installation shall be in accordance with the manufacturer's recommendations.
- B Doors shall fit snugly and close without forcing or binding. Door clearances shall not exceed 1/8 inch at jambs and heads and meeting stiles at pairs of doors. Clearances between bottom of door and finished floor material or threshold shall not exceed 1/4-inch. Frames shall be manufactured and machined to within 1/32 inch for all dimensions.

3.03 PROTECTION

- A The Contractor shall protect installation from damage and touch up scratched areas with same paint used for shop coats. Damaged work shall be repaired or replaced.

3.04 DOOR SCHEDULE

- A Door schedules indicating the door marks, type of door, the approximate building wall openings and the calculated design wind pressures are shown on the Drawings.

- END OF SECTION -

SECTION 08710 - FINISH HARDWARE

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The CONTRACTOR shall furnish and install items known commercially as finish or door hardware that are required for swing, sliding, and folding doors, except special types of unique hardware specified in the same sections as the doors and door frames on which they are to be installed.
- B. This Section includes the following:
 - 1. Hinges.
 - 2. Key control systems.
 - 3. Lock cylinders and keys.
 - 4. Lock and latch sets.
 - 5. Bolts.
 - 6. Exit devices.
 - 7. Push/pull units.
 - 8. Closers.
 - 9. Overhead holders.
 - 10. Miscellaneous door control devices.
 - 11. Door trim units.
 - 12. Protection plates.
 - 13. Weatherstripping for exterior doors.
 - 14. Sound stripping for doors.
 - 15. Automatic drop seals (door bottoms).
 - 16. Astragals or meeting seals on pairs of doors.
 - 17. Thresholds.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 08110 – Steel Doors and Frames

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Codes: All codes, as referenced herein, are specified in Section 01090 - Reference Standards.
- B. Commercial Standards
 - 1. Underwriters' Laboratories, Inc. (UL) requirements and approvals.
 - 2. Hardware Institute (DHI) Recommended Procedure for Processing Hardware Schedules and Templates and Architectural Hardware Scheduling and Format.
 - 3. BHMA, Builder's Hardware Manufacturers' Association
- C. Manufacturer's Standards: In addition to the standards listed above, the finish hardware and its installation shall be in accordance with the manufacturer's published recommendations and specifications.

1.04 SUBMITTALS

- A. General: Submit the following in accordance with Section 01300 entitled "Submittals":
 - 1. Product data including manufacturer's technical product data for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.
 - 2. Final hardware schedule coordinated with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware. Finish hardware shall be submitted concurrent with door shop drawings.
 - a. Final Hardware Schedule Content: Based on hardware indicated, organize schedule into "hardware sets" indicating complete designations of every item required for each door or opening. Include the following information:
 - 1) Type, style, function, size, and finish of each hardware item.
 - 2) Name and manufacturer of each item.
 - 3) Fastenings and other pertinent information.
 - 4) Location of each hardware set cross referenced to indications on Drawings, both on floor plans and in door and frame schedule.
 - 5) Explanation of all abbreviations, symbols, and codes contained in schedule.

- 6) Door and frame sizes and materials.
- 7) Keying information.
- b. Submittal Sequence: Submit final schedule at earliest possible date, particularly where acceptance of hardware schedule must precede fabrication of other work that is critical in the Project construction schedule. Include with schedule the product data, samples, shop drawings of other work affected by door hardware, and other information essential to the coordinated review of schedule.
- c. Keying Schedule: Submit separate detailed schedule indicating clearly how the CITY's final instructions on keying of locks has been fulfilled.
- 3. If requested by ENGINEER, submit samples of each type of exposed hardware unit in finish indicated and tagged with full description for coordination with schedule. Submit samples prior to submission of final hardware schedule.
 - a. Samples will be returned to the supplier. Units that are acceptable and remain undamaged through submittal, review, and field comparison process may, after final check of operation, be incorporated in the Work, within limitations of keying coordination requirements.
- 4. Templates for doors, frames, and other work specified to be factory prepared for the installation of door hardware. Check shop drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

1.05 QUALITY ASSURANCE

- A. Single Source Responsibility: Obtain each type of hardware (latch and lock sets, hinges, closers, etc.) from a single manufacturer. All door locks shall be keyed to a keying schedule developed by the CITY and manufacturer.
- B. Supplier Qualifications: A recognized architectural door hardware supplier, with warehousing facilities in the Project's vicinity, that has a record of successful in-service performance for supplying door hardware similar in quantity, type, and quality to that indicated for this Project and that employs an experienced architectural hardware consultant (AHC) who is available to CITY, Architect, and CONTRACTOR, at reasonable times during the course of the Work, for consultation.
 - 1. Require supplier to meet with CITY to finalize keying requirements and to obtain final instructions in writing.
 - 2. Supplier shall be an authorized factory distributor of all specified products.
- C. Fire-Rated Openings: Provide door hardware for fire-rated openings that complies with NFPA Standard No. 80 and requirements of authorities having jurisdiction. Provide only items of door hardware that are listed and are identical to products tested by UL, Warnock Hersey, FM, or other testing and inspecting organization acceptable to

authorities having jurisdiction for use on types and sizes of doors indicated in compliance with requirements of fire-rated door and door frame labels.

1.06 PRODUCT HANDLING

- A. Tag each item or package separately with identification related to final hardware schedule, and include basic installation instructions with each item or package.
- B. Packaging of door hardware is responsibility of supplier. As material is received by hardware supplier from various manufacturers, sort and repackage in containers clearly marked with appropriate hardware set number to match set numbers of approved hardware schedule. Two or more identical sets may be packed in same container.
- C. Inventory door hardware jointly with representatives of hardware supplier and hardware installer until each is satisfied that count is correct.
- D. Deliver individually packaged door hardware items promptly to place of installation (shop or Project site).
- E. Provide secure lock-up for door hardware delivered to the Project, but not yet installed. Control handling and installation of hardware items that are not immediately replaceable so that completion of the Work will not be delayed by hardware losses both before and after installation.

1.07 MAINTENANCE

- A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for CITY's continued adjustment, maintenance, and removal and replacement of door hardware.

PART 2 -- PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Butts and Hinges:
 - a. Hager Hinge Co.
 - b. McKinney Products Co.
 - c. Stanley Hardware, Div. Stanley Works.
 - 2. Cylinders and Locks:
 - a. Sargent Manufacturing Company.
 - b. Schlage Lock, Div. Ingersoll-Rand Door Hardware Group.

- c. Dormakaba
- 3. Exit/Panic Devices:
 - a. Sargent Manufacturing Company.
 - b. Von Duprin, Div. Ingersoll-Rand Door Hardware Group.
- 4. Push/Pull Units:
 - a. H.B. Ives, A Harrow Company.
 - b. Quality Hardware Mfg. Co., Inc.
 - c. Rockwood Mfg. Co.
- 5. Overhead Closers:
 - a. LCN, Div. Ingersoll-Rand Door Hardware Group.
 - b. Sargent Manufacturing Company.
- 6. Bolts:
 - a. H.B. Ives, A Harrow Company.
 - b. Quality Hardware Mfg. Co., Inc.
 - c. Rockwood Mfg. Co.
- 7. Door Trim Units:
 - a. H.B. Ives, A Harrow Company.
 - b. Quality Hardware Mfg. Co., Inc.
 - c. Rockwood Mfg. Co.
- 8. Kick, Mop, and Armor Plates:
 - a. Rockwood Mfg. Co.
 - b. H.B. Ives, A Harrow Company.
 - c. Quality Hardware Mfg Co., Inc.
- 9. Key Control System:
 - a. Key Control Systems, Inc.
 - b. Telkee Inc.

- c. Dormakaba
- 10. Thresholds, Door Stripping and Seals, Automatic Drop Seals, Astragals:
 - a. National Guard Products, Inc.
 - b. Pemko Manufacturing Co., Inc.
 - c. Reese Enterprises, Inc.

2.02 SCHEDULED HARDWARE

- A. Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of finish hardware are indicated in the "Hardware Schedule" at the end of this Section. Products are identified by using hardware designation numbers of the following:
 - 1. Manufacturer's Product Designations: The product designation and name of one manufacturer are listed for each hardware type required for the purpose of establishing minimum requirements. Provide either the product designated or, where more than one manufacturer is specified under the Article "Manufacturers" in Part 2 for each hardware type, the comparable product of one of the other manufacturers that complies with requirements.
 - 2. ANSI/BHMA designations used elsewhere in this Section or in schedules to describe hardware items or to define quality or function are derived from the following standards. Provide products complying with these standards and requirements specified elsewhere in this Section.
 - a. Butts and Hinges: ANSI/BHMA A156.1.
 - b. Bored and Preassembled Locks and Latches: ANSI/BHMA A156.2.
 - c. Exit Devices: ANSI/BHMA A156.3.
 - d. Door Controls - Closers: ANSI/BHMA A156.4.
 - e. Auxiliary Locks and Associated Products: ANSI/BHMA A156.5.
 - f. Architectural Door Trim: ANSI/BHMA A156.6.
 - g. Template Hinge Dimensions: ANSI/BHMA A156.7.
 - h. Door Controls - Overhead Holders: ANSI/BHMA A156.8.
 - i. Interconnected Locks and Latches: ANSI/BHMA A156.12.
 - j. Mortise Locks and Latches: ANSI/BHMA A156.13.
 - k. Sliding and Folding Door Hardware: ANSI/BHMA A156.14.

- I. Closer Holder Release Devices: ANSI/BHMA A156.15.
- m. Auxiliary Hardware: ANSI/BHMA A156.16.
- n. Self-Closing Hinges and Pivots: ANSI/BHMA A156.17.
- o. Materials and Finishes: ANSI/BHMA A156.18.

2.03 MATERIALS AND FABRICATION

- A. Manufacturer's Name Plate: Do not use manufacturers' products that have manufacturer's name or trade name displayed in a visible location (omit removable nameplates) except in conjunction with required fire-rated labels and as otherwise acceptable to Architect.
 - 1. Manufacturer's identification will be permitted on rim of lock cylinders only.
- B. Base Metals: Produce hardware units of basic metal and forming method indicated using manufacturer's standard metal alloy, composition, temper, and hardness, but in no case of lesser (commercially recognized) quality than specified for applicable hardware units for finish designations indicated.
- C. Fasteners: Provide hardware manufactured to conform to published templates, generally prepared for machine screw installation. Do not provide hardware that has been prepared for self-tapping sheet metal screws, except as specifically indicated.
- D. Furnish screws for installation with each hardware item. Provide Phillips flat-head screws except as otherwise indicated. Finish exposed (exposed under any condition) screws to match hardware finish or, if exposed in surfaces of other work, to match finish of this other work as closely as possible including "prepared for paint" surfaces to receive painted finish.
- E. Provide concealed fasteners for hardware units that are exposed when door is closed except to the extent no standard units of type specified are available with concealed fasteners. Do not use thru-bolts for installation where bolt head or nut on opposite face is exposed in other work unless their use is the only means of reinforcing the work adequately to fasten the hardware securely. Where thru-bolts are used as a means of reinforcing the work, provide sleeves for each thru-bolt or use hex screw fasteners.

2.04 HINGES, BUTTS, AND PIVOTS

- A. Templates: Except for hinges and pivots to be installed entirely (both leaves) into wood doors and frames, provide only template-produced units.
- B. Screws: Provide Phillips flat-head screws complying with the following requirements:
 - 1. For metal doors and frames install machine screws into drilled and tapped holes.
 - 2. Finish screw heads to match surface of hinges or pivots.

- C. Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:
 - 1. Out-Swing Exterior Doors: Nonremovable pins.
 - 2. Interior Doors: Nonrising pins.
 - 3. Tips: Flat button and matching plug, finished to match leaves, except where hospital tip (HT) is indicated.
- D. Number of Hinges: Provide number of hinges indicated but not less than 3 hinges per door leaf for doors 90 inches or less in height and one additional hinge for each 30 inches of additional height.
 - 1. Fire-Rated Doors: Not less than 3 hinges per door leaf for doors 86 inches or less in height with same rule for additional hinges.

2.05 LOCK CYLINDERS AND KEYING

- A. Review the keying system with the CITY and provide the type required (master, grandmaster or great-grandmaster), either new or integrated with CITY's existing system.
- B. Equip locks with manufacturer's special 6-pin tumbler cylinder with construction masterkey feature that permits voiding of construction keys without cylinder removal.
- C. Metals: Construct lock cylinder parts from brass or bronze, stainless steel, or nickel silver.
- D. Comply with CITY's instructions for masterkeying and, except as otherwise indicated, provide individual change key for each lock that is not designated to be keyed alike with a group of related locks.
- E. Key Material: Provide keys of nickel silver only.
- F. Key Quantity: Furnish 2 change keys for each lock, 5 master keys for each master system, and 5 grand masterkeys for each grandmaster system.
 - 1. Deliver keys to CITY.

2.06 KEY CONTROL SYSTEM

- A. Provide a key control system including envelopes, labels, tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet, all as recommended by system manufacturer, with capacity for 150 percent of the number of locks required for the Project.
 - 1. Provide hinged-panel type cabinet for wall mounting.

2.07 LOCKS, LATCHES, AND BOLTS

- A. Strikes: Provide manufacturer's standard wrought box strike for each latch or lock bolt, with curved lip extended to protect frame, finished to match hardware set, unless otherwise indicated.
 - 1. Provide flat lip strikes for locks with 3-piece, antifriction latchbolts as recommended by manufacturer.
 - 2. Provide extra long strike lips for locks used on frames with applied wood casing trim.
 - 3. Provide recess type top strikes for bolts locking into frame heads, unless otherwise indicated.
 - 4. Provide dust-proof strikes for foot bolts, except where special threshold construction provides nonrecessed strike for bolt.
 - 5. Provide roller type strikes where recommended by manufacturer of the latch and lock units.
- B. Lock Throw: Provide 5/8-inch minimum throw of latch on pairs of doors. Comply with UL requirements for throw of bolts and latch bolts on rated fire openings.
 - 1. Provide 1/2-inch minimum throw of latch for other bored and preassembled types of locks and 3/4-inch minimum throw of latch for mortise locks. Provide 1-inch minimum throw for all dead bolts.
- C. Flush Bolt Heads: Minimum of 1/2-inch-diameter rods of brass, bronze, or stainless steel with minimum 12-inch-long rod for doors up to 7'-0" in height. Provide longer rods as necessary for doors exceeding 7'-0" in height.
- D. Rabbeted Doors: Where rabbeted door stiles are indicated, provide special rabbeted front on lock and latch units and bolts.

2.08 PUSH/PULL UNITS

- A. Exposed Fasteners: Provide manufacturer's standard exposed fasteners for installation, thru-bolted for matched pairs but not for single units.

2.09 CLOSERS AND DOOR CONTROL DEVICES

- A. All closers shall be constructed with rack and pinion with compression springs. The Closing speed, latching speed and backcheck shall be controlled by key operated valves. The delay action feature shall be a separate key operated valve. The closer body shall be manufactured of high performance cast aluminum silicon alloy. All door closers shall be suitable for standard, top jamb, track, corner bracket and parallel arm applications when provided with proper brackets and arms. The closer should be adjustable to meet the range of sizes required for opening and closing forces.
- B. Access-Free Manual Closers: Where manual closers are indicated for doors required to be accessible to the physically handicapped, provide adjustable units complying with ANSI A117.1 provisions for door opening force and delayed action closing.

2.10 DOOR TRIM UNITS

- A. Fasteners: Provide manufacturer's standard exposed fasteners for door trim units consisting of either machine screws or self-tapping screws.

2.11 WEATHERSTRIPPING AND SEALS

- A. General: Provide continuous weatherstripping on exterior doors and smoke, light, or sound seals on interior doors where indicated or scheduled. Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

2.12 THRESHOLDS

- A. General: Except as otherwise indicated, provide standard metal threshold unit of type, size, and profile as shown or scheduled.

2.13 HARDWARE FINISHES

- A. The designations used in schedules and elsewhere to indicate hardware finishes are the industry-recognized standard commercial finishes.
 - 1. Stainless steel, US32D unless otherwise noted.
 - 2. Closers shall have a USP finish unless otherwise noted.

PART 3 -- EXECUTION

3.01 INSTALLATION

- A. Mount hardware units at heights indicated in following applicable publications, except as specifically indicated or required to comply with governing regulations:
 - 1. "Recommended Locations for Builders Hardware for Standard Steel Doors and Frames" by the Door and Hardware Institute.
- B. Install each hardware item in compliance with the manufacturer's instructions and recommendations. Where cutting and fitting is required to install hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation or application of surface protection with finishing work specified in the Division 9 Sections. Do not install surface-mounted items until finishes have been completed on the substrates involved.
- C. Set units level, plumb, and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.
- D. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.

- E. Set thresholds for exterior doors in full bed of butyl-rubber or polyisobutylene mastic sealant.
- F. Weatherstripping and Seals: Comply with manufacturer's instructions and recommendations to the extent installation requirements are not otherwise indicated.

3.02 ADJUSTING, CLEANING, AND DEMONSTRATING

- A. Adjust and check each operating item of hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate freely and smoothly or as intended for the application made.
 - 1. Where door hardware is installed more than one month prior to acceptance or occupancy of a space or area, return to the installation during the week prior to acceptance or occupancy and make final check and adjustment of all hardware items in such space or area. Clean operating items as necessary to restore proper function and finish of hardware and doors. Adjust door control devices to compensate for final operation of heating and ventilating equipment.
- B. Clean adjacent surfaces soiled by hardware installation.
- C. Instruct CITY's personnel in the proper adjustment and maintenance of door hardware and hardware finishes.
- D. Six-Month Adjustment: Approximately six months after the date of Substantial Completion, the Installer, accompanied by representatives of the manufacturers of latchsets and locksets and of door control devices, and of other major hardware suppliers, shall return to the Project to perform the following work:
 - 1. Examine and re-adjust each item of door hardware as necessary to restore function of doors and hardware to comply with specified requirements.
 - 2. Consult with and instruct CITY's personnel in recommended additions to the maintenance procedures.

3.03 HARDWARE SCHEDULE

- A. General: Provide hardware for each door to comply with requirements of this Section, hardware set numbers indicated in the door schedule on the Drawings, and in the following schedule of hardware sets.

Hardware Set No. 1 – Single Leaf Exit Door

3 EA ¹	Hinge	McKinney	T4A3386	4.5 x 4.5 NRP	32 D
1 EA	Exit Device	Sargent	HC8813ETJ		32 D
1 EA	Closer	Dorma	8616 STA ARP SN		AL
1EA	Mechanical Pushbutton Lock	Dormakaba	Simplex L1000		

1 EA	Threshold	Pemko	2005AS	AL
1 EA	Jamb Seal	Pemko	S88D	AL

¹Use 4 Nos. for doors greater than 7'-0" high

- END OF SECTION -

DIVISION 9 – FINISHES

SECTION 09900 - PAINTING

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The CONTRACTOR shall furnish all labor, tools, materials, supervision and equipment necessary to do all the work specified herein and as required for a complete installation, including surface preparation, priming and painting of CONTRACTOR furnished equipment, materials, and structures.
- 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 GENERAL INFORMATION AND DESCRIPTION

- A. The term "paint," as used herein, includes emulsions, enamels, paints, stains, varnishes, sealers, cement filler, cement-latex filler and other coatings, whether used as prime, intermediate, or finish coats.
- B. All paint for concrete and metal surfaces shall be especially adapted for use around wastewater treatment plants and shall be applied in conformance with the manufacturer's published specifications.
- C. All paint for final coats shall be fume resistant, compounded with pigments suitable for exposure to sewage gases, especially to hydrogen sulfide and to carbon dioxide. Pigments shall be materials which do not tend to darken, discolor, or fade due to the action of sewage gases. If a paint manufacturer proposes use of paint which is not designated "fume resistant" in its literature, it shall furnish full information concerning the pigments used in this paint.
- D. 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.

- E. Coatings used in conjunction with potable water supply systems shall have U.S. Environmental Protection Agency (EPA) and FDA approval for use with potable water and shall not impart a taste or odor to the water.
- F. All building, facilities, structures, and appurtenances, as indicated on the Drawings and as specified herein, shall be painted with not less than 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.
- G. 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. A list of surfaces not to be coated is included in Article 1.11 of this Section.
- H. 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.
- I. The CONTRACTOR shall obtain all permits, licenses and inspections and shall comply with all laws, codes, ordinances, rules and regulations promulgated by authorities having jurisdiction which may bear on the work. This compliance will include Federal Public Law 91-596 more commonly known as the "Occupational Safety and Health Act of 1970".

1.03 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 03350 – Concrete Finishes
- B. Section 03370 – Concrete Curing

1.04 REFERENCE SPECIFICATION, 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 No. 1) White Metal Blast Cleaning

- e. SSPC-SP6 (NACE No. 3) Commercial Blast Cleaning
- f. SSPC-SP10 (NACE No. 2) Near-White Metal Blast
- g. SSPC-SP13 (NACE No. 6) Surface Preparation of Concrete
- 2. NACE - National Association of Corrosion Engineers
- 3. ASTM D1737 - Test Method for Elongation of Attached Organic Coatings with Cylindrical Mandrel Apparatus
- 4. ASTM B117 - Method of Salt Spray (Fog) Testing
- 5. ASTM D4060 - Test Method for Abrasion Resistance of Organic Coating by the Taber Abraser
- 6. ASTM D3359 - Method for Measuring Adhesion by Tape Test

1.05 MANUFACTURERS

- A. All painting materials shall be as manufactured by Tnemec, Carboline, Ameron, PPG or Sherwin Williams.

1.06 SUBMITTALS

- A. The CONTRACTOR shall submit paint manufacturer's data sheets, application instructions, and samples of each finish and color to the ENGINEER for review, before any work is started in accordance with Section 01300 entitled, "Submittals."
- B. 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.
- C. The CONTRACTOR shall prepare a complete schedule of surfaces to be coated and shall identify the surface preparation and paint system he proposes to use. The Paint Schedule shall be in conformance with Article 3.03 of this Section. The schedule shall contain the name of the paint manufacturer, and the name, address and telephone number of the manufacturer's representative that will inspect the Work. The schedule shall be submitted to the ENGINEER for review as soon as possible following the Notice to Proceed so that the schedule may be used to identify colors and to specify shop painting systems on order for fabricated equipment.
- D. Name and detailed qualifications of the protective coating applicator or subcontractor. Qualifications shall include, but not be limited to, five (5) 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.

1.07 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.

1.08 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
 - l. 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.

1.09 QUALITY ASSURANCE

- A. 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.
- B. 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.
- C. 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.
- D. The CONTRACTOR shall provide references of the coating applicator or subcontractor per article 1.06, D.

1.10 SAFETY AND HEALTH REQUIREMENTS

- A. In accordance with requirements of OSHA Safety and Health Standards for Construction (29CFR1926) and the applicable requirements of regulatory agencies having jurisdiction, as well as manufacturer's printed instructions, appropriate technical bulletins, manuals, and material safety data sheets, the CONTRACTOR shall provide and require use of personnel protective and safety equipment for persons working in or about the project site.
- 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.

1.11 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, nameplates, serial numbers and operating instruction labels.
12. Any code-requiring 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 the work whenever such covering is necessary, or if so requested by the CITY. Any unwanted paint shall be carefully removed without damage to any finished paint or surface. If damage does occur, the entire surface, adjacent to and including the damaged area, shall be repainted without visible lapmarks and without additional cost to the CITY.

- B. Painting found defective shall be scraped or sandblasted off and repainted as the CITY may direct. Before final acceptance of the work, damaged surfaces of paint shall be cleaned and repainted as directed by the CITY.

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 SHIPPING, HANDLING AND STORAGE

- A. All painting materials shall be brought to the job site in the original sealed labeled containers of the paint manufacturer and shall be subject to review by the ENGINEER. Where thinning is necessary, only the product of the manufacturer furnishing the paint shall be used. All such thinning shall be done strictly in accordance with the manufacturer's instructions, and with the full knowledge of the ENGINEER.
- B. Materials and their storage shall be in full compliance with the requirements of pertinent codes and fire regulations. Receptacles shall be placed outside buildings for paint gates and containers. Paint waste shall not be disposed of in plumbing fixtures, process drains or other plant systems or process units.

PART 2 -- PRODUCTS

2.01 MATERIALS

- A. Table 09900-1 depicts the coatings referenced in Article 3.03 of this Section entitled, "Paint Schedule". Table 09900-1 lists Tnemec products as a reference. Equivalent products by the manufacturers listed in Article 1.05 of this Section may be submitted for review.

**Table 09900-1
Product Listing**

Ref. No.	Description	MANUFACTURERS REFERENCE Tnemec
104	Polyamidoamine Epoxy Primer	N69 – 1211
105	Polyamidoamine Epoxy	N69 – Color
110	Aliphatic Acrylic Polyurethane	73 – Color
111	Modified Waterborne Acrylate	156 - Envirocrete (Smooth Texture)
114	Waterborne Modified Polyamine Epoxy	151-1051 Elasto-Grip
115	Aromatic Urethane, Zinc Rich	90-97

Ref. No.	Description	MANUFACTURERS REFERENCE Tnemec
119	Cycloaliphatic Amine Epoxy	104 H.S. Epoxy
123	Waterborne Epoxy	287-Envirothead

2.02 TRAFFIC PAINT

- A. Paint for marking the parking lots shall be Sherwin-Williams PRO-MAR traffic marking paint, or equal. Color shall be white. Paint shall be applied in accordance with the manufacturer's recommendations.

PART 3 -- EXECUTION

3.01 SURFACE PREPARATION

A. General

1. Surfaces to be painted shall be clean and dry, and free of dust, rust, scale and all foreign matter. No solvent cleaning, power or hand tool cleaning shall be permitted unless acceptable to the Engineer or specified herein.
2. Hardware accessories, machined surfaces, plates, lighting fixtures, and similar items in place prior to cleaning and painting, and not intended to be painted, shall be protected or removed during painting operations and repositioned upon completion of painting operations.
3. 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.
4. 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.
5. 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. Touch-up coats are in addition to the specified applied systems, and not considered a field coat.
6. 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
7. Sand from sandblasting shall be thoroughly removed, using a vacuum cleaner if necessary. No surface which has been sandblasted shall be painted until inspected by the Engineer.

B. Metal Surfaces

1. Except as otherwise provided, all preparation of metal surfaces shall be in accordance with Specifications SP-1 through SP-10 of the Society for Protective Coatings (SSPC). Where the Society for Protective Coatings Specifications are referred to in these Contract Documents, the corresponding Pictorial Surfaces Preparation Standard shall be used to define the minimum final surface conditions to be supplied. Grease and oil shall be removed and the surface prepared by hand tool cleaning, power tool cleaning or blast cleaning in accordance with the appropriate Specification SP-1 through SP-30.
2. 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.
3. Weld flux, weld spatter and excessive rust scale shall be removed by power tool cleaning as per SSPC-SP-3.
4. All ferrous metal surfaces not required to be galvanized shall be cleaned of all oil grease, dirt, rust and tight and loose mill scale by blasting in accordance with the following: SSPC-SP-5 White Metal Blast Cleaning and comply with the visual standard NACE No. 1, for shop prepared and shop primed metal to be submerged or in a corrosive environment, SSPC-SP10 Near White Metal Blast Cleaning, and comply with the visual standard NACE No. 2 for field prepared metal to be submerged or in a corrosive environment, SSPC-SP6 and comply with the visual standard NACE No. 3 for metal in all other locations. Pickling, complying with SSPC-SP-8, may be substituted for Near White Blast in areas as determined by the Engineer. Priming shall follow sandblasting before any evidence of corrosion occurs, before nightfall and before any moisture is on the surface.
5. 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.
6. All coated surfaces shall be cleaned prior to application of successive coats. All non-ferrous metals not to be coated shall be cleaned. This cleaning shall be done in accordance with SSPC-SP-1, Solvent Cleaning.

7. 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.
8. 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 Surfaces

1. Concrete surfaces are to be cured for at least 28 days prior to surface preparation, unless coatings are recommended for application over green concrete surfaces.
2. Test concrete for moisture content, pH and salts using test method recommended by the paint manufacturer. Do not begin surface preparation, or painting until moisture content is acceptable to manufacturer.
3. Non-submerged concrete and masonry surfaces to be painted shall be prepared by removing efflorescence, chalk, dust, dirt, grease, oil, form coating, tar and by roughening to remove glaze. All surfaces shall be repaired prior to commencement of the coating operation.
4. Concrete immersion surfaces that are to be coated shall be prepared in accordance to SSPC-SP13/NACE No. 6 to remove all laitance, curing compounds, hardeners, sealers, and other contaminants, and to provide a minimum surface profile. Refer to manufacturer's recommendation for specific coating being applied and adhere to ICRI Concrete Surface Preparation Profiles (CSP 1-10) when reviewing concrete surface preparation. Areas of concrete which contain bug holes or voids shall be filled with the manufacturer's approved filler material.

D. Masonry

1. Cure for a minimum of 28 days prior to surface preparation or 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.

E. 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.

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. 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.

H. PVC Pipe Surfaces

1. All pipe surfaces shall be cleaned and lightly sanded before painting.

I. Existing 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.

1.

3.02 SHOP PAINTING

- A. All fabricated steel work and equipment shall receive at the factory at least one shop coat of prime paint compatible with the paint system required by these Specifications. The CONTRACTOR shall coordinate all shop priming to ensure compatibility with paint system specified. Surface preparation prior to shop painting shall be as specified. Finish coats may be applied in the shop if acceptable to 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 Work shall be equal to the original painting received at the shop. Equipment or steel Work that is to be assembled on the site shall likewise receive a minimum of one shop coat of paint at the factory. Surfaces of exposed members that will be inaccessible after erection shall be prepared and painted before erection.
- B. The CONTRACTOR shall specify the shop paints to be applied when ordering equipment 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 submitted to the ENGINEER for review. Shop paint shop drawings will not be reviewed until the final project paint system has been submitted by the CONTRACTOR and reviewed by the ENGINEER.
- C. 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.

3.03 PAINT SCHEDULE

- A. The CONTRACTOR shall adhere to this paint schedule, providing those paints named or equal. DFT shall mean the minimum dry film thickness per application measured in mils. Products are referenced by numbers listed in Article 2.01 of this Section entitled "Product Listing." The paint schedule identifies the minimum DFT required per coat. If the CONTRACTOR does not achieve the specified DFT range in a single coat, it shall provide additional coats as necessary at no additional cost to the CITY.
- B. Metal Surfaces, Atmospheric (Exterior) Exposure
 - 1. Metal surfaces exposed to the atmosphere that do not come into contact with wastewater or corrosive atmosphere including the following types of surfaces shall be painted as described below:
 - a. Pumps, motors, process equipment, machinery, etc.
 - b. Above ground piping, valves and pipe supports.
 - c. Miscellaneous steel shapes, angles, etc.

- d. Exposed surfaces of conduit, ductwork, etc.
2. Surface preparation: SSPC-SP6

Ferrous Metal

<u>Application</u>	<u>No.</u>	<u>Description</u>	<u>DFT</u>
First - 1 coat	104	Hi-Build Epoxoline II Primer	3.0 - 5.0
Second - 1 coat	105	Hi-Build Epoxoline II	2.0 - 3.0
Finish - 1 coat	110	Endura Shield III	<u>2.0 - 3.0</u>
Min. Total			9.0 Mils

Non-Ferrous Metal

<u>Application</u>	<u>No.</u>	<u>Description</u>	<u>DFT</u>
First - 1 coat	105	Hi-Build Epoxoline II	2.0 - 3.0
Second - 1 coat	110	Endura Shield III	<u>2.0 - 3.0</u>
Min. Total			5.0 Mils

Galvanized

<u>Application</u>	<u>No.</u>	<u>Description</u>	<u>DFT</u>
Spot Repair	115	Aromatic Urethane, Zinc-Rich	2.0-3.0(spot)
First - 1 coat	105	Hi-Build Epoxoline II	2.0 - 3.0
Second - 1 coat	110	Endura Shield III	<u>2.0 - 3.0</u>
Min. Total			5.0 Mils

C. Metal Surfaces, Interior Exposure

1. Interior metal surfaces (nonsubmerged) that do not come in contact with wastewater or the corrosive atmosphere including the following types of surfaces shall be painted as follows:
 - a. Pumps, motors, process equipment, machinery, etc.
 - b. Piping, valves and supports.
 - c. Miscellaneous steel shapes, angles, rails, etc.
 - d. Exposed surfaces of conduit, ductwork, etc.
2. Surface preparation: SSPC-SP6

<u>Application</u>	<u>No.</u>	<u>Description</u>	<u>DFT</u>
First - 1 coat	104	Hi-Build Epoxoline II Primer	3.0 - 5.0
Finish - 1 coat	105	Hi-Build Epoxoline II	<u>4.0 - 6.0</u>

Min. Total 9.0 Mils

D. Metal Surfaces, Submerged Exposure

1. Metal surfaces that are submerged in wastewater or subjected to wastewater gases shall be painted as described below:
2. Surface preparation: SSPC-SP5

<u>Application</u>	<u>No.</u>	<u>Description</u>	<u>DFT</u>
Stripe coat	119	High Solids Epoxy	3.0 – 5.0
First – 1 coat	119	High Solids Epoxy	4.0 – 6.0
Finish - 1 coat	119	High Solids Epoxy	4.0 – 6.0
Min. Total (excluding stripe coat)			10.0 Mils

E. Ductile Iron Pipe, Exterior or Interior Exposure

1. Ductile iron pipe exterior or interior exposure shall receive the following types of paint:
2. Surface preparation: SSPC-SP6

<u>Application</u>	<u>No.</u>	<u>Description</u>	<u>DFT</u>
First - 1 coat	105	Hi-Build Epoxoline II	6.0 - 10.0
Finish - 1 coat	110	Endura Shield III	<u>3.0 - 5.0</u>
Min. Total			12.0 Mils

F. PVC/CPVC Pipes, Exterior or Interior Exposure

1. PVC/CPVC pipes, valves, and accessories, shall receive the following types of paint:
2. Surface preparation: Light sanding

<u>Application</u>	<u>No.</u>	<u>Description</u>	<u>DFT</u>
First - 1 coat	105	Hi-Build Epoxoline II	2.0 - 3.0
Finish - 1 coat	110	Endura Shield III	<u>2.0 - 3.0</u>
Min. Total			5.0 Mils

G. Existing Concrete, Stucco and Masonry Surfaces identified for painting or requiring Touch-Up caused by CONTRACTOR's Construction Activities, Exterior Exposure

1. Exteriors of existing structures shall be painted as identified herein. Paint colors and color scheme shall match existing.
 - a. RAS PS No. 1

- b. Oxygenation Train Nos. 1 and No. 2 Tanks, where structural rehabilitation necessitates paint repair.
2. Surface preparation: Remove unsound paint, excess mortar, laitance, and efflorescence. Pressure wash with TSP/Chlorine solution and fresh water rinse.

<u>Application</u>	<u>No.</u>	<u>Description</u>	<u>DFT</u>
First - 1 coat	114	Waterborne Polyamide Epoxy	1.0 - 2.5
Brush - 1 coat*	111	Modified Waterborne Acrylate	4.0 - 6.0
Finish - 1 coat	111	Modified Waterborne Acrylate	<u>4.0 - 6.0</u>
Min. Total			10.0 Mils

**(Apply a brush coat of TNEMEC Series 156 Enviro-Crete into all exposed cracks prior to application of finish coat.)*

- H. Existing Painted Concrete and Masonry Surfaces noted for coating or requiring touch-up caused by CONTRACTOR's construction activities or identified herein to be coated, Interior Exposure
1. Interior exposed masonry and concrete surfaces including the entire interior surfaces shall be painted as described below:
2. Surface preparation: Remove unsound paint, excess mortar, laitance, and efflorescence. Pressure wash with TSP/Chlorine solution and fresh water rinse.

<u>Application</u>	<u>No.</u>	<u>Description</u>	<u>DFT</u>
First - 1 coat	105	Hi-Build Epoxoline II	4.0 - 6.0
Finish - 1 coat	105	Hi-Build Epoxoline II	<u>4.0 - 6.0</u>
Minimum Total			10.0 Mils

I. Interior concrete floor surfaces

1. Surface Preparation: Remove all dirt, oil, grease, chemicals and other surface contaminants by pressure cleaning (Minimum 3000 psi). Remove all loose or damaged coatings and concrete. Scarify all sound tightly adhering coatings by sanding. All surfaces shall be clean, dry and contain only sound tightly adhering, scarified coatings prior to repainting.

<u>Application</u>	<u>No.</u>	<u>Description</u>	<u>DFT</u>
Spot Primer	123	Waterborne Epoxy	2.0 - 4.0
First Coat*	123	Waterborne Epoxy	2.0 - 4.0
Second Coat	123	Waterborne Epoxy	<u>2.0 - 4.0</u>
Total for Two (2) Full Coats			4.0 - 8.0

**Broadcast skid resistant sand into the first coat while still wet.*

3.04 PAINTING

A. All paint shall be applied by experienced painters with brushes or other applicators acceptable to the ENGINEER.

1. Paint shall be applied without runs, sags, thin spots, or unacceptable marks. Paints shall be applied at the rate specified by the manufacturer to achieve the minimum dry mil thickness required. Additional coats of paint shall be applied, if necessary, to obtain thickness specified.
2. 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.
3. 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.

B. Drying Time

1. A minimum of twenty-four hours drying time shall elapse between application of any two coats of paint on a particular surface unless shorter time periods are a requirement of the manufacturer or specified herein. Longer drying times shall be required for abnormal conditions as defined by the manufacturer.

C. Weather Restrictions

1. No painting whatsoever shall be accomplished in rainy or excessively damp weather when the relative humidity exceeds 85 percent, or when the general air temperature cannot be maintained at 50 degrees Fahrenheit or above throughout the entire drying period. No paint shall be applied when it is expected that the relative humidity will exceed 85 percent or that the air temperature will drop below 50 degrees Fahrenheit within 18 hours after the application of the paint.
2. Dew or moisture condensation should be anticipated; and if such conditions are prevalent, painting shall be delayed until midmorning to be certain the surfaces are dry. The day's painting shall be completed well in advance of the probable time-of-day when condensation will occur.

D. Inspection of Surfaces

1. Surface preparation and every field coat of priming and finishing paint shall be inspected by the Engineer or his authorized representative before the succeeding coat is applied. The Contractor shall follow a system of tinting successive paint coats so that no two coats for a given surface are exactly the same color. Areas to receive black protective coatings shall in such cases be tick-marked with white or actually gauged as to thickness when finished.

2. 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.
3. Samples of surface preparation and of painting systems shall be furnished by the Contractor to be used as a standard throughout the job, unless omitted by the Engineer.
4. 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.
5. 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.
6. 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.
7. Coatings shall pass a holiday detector test.
8. 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.
9. 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.
 - a. 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.
 - b. 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.

H. Special Areas

1. 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.

- I. Special attention shall be given to insure that edges, corners, crevices, welds and rivets receive a film thickness equivalent to that of the adjacent painted surfaces.

J. Safety

1. 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.

K. Quality Workmanship

1. The Contractor shall be responsible for the cleanliness of his painting operations and shall use covers and masking tape to protect the Work whenever such covering is necessary, or if so requested by the City. Any unwanted paint shall be carefully removed without damage to any finished paint or surface. If damage does occur, the entire surface, adjacent to and including the damaged area, shall be repainted without visible lap marks and without additional cost to the City.

- 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.

3.05 SCHEDULE OF COLORS

- A. All colors shall be as designated by the ENGINEER at the shop drawing review. The CONTRACTOR shall submit color samples including custom color choices as required to the ENGINEER as specified in Article 1.04 of this Section. The CONTRACTOR shall submit suitable samples of all colors and finishes for the surfaces to be painted, or on portable surfaces when required by the ENGINEER. The ENGINEER shall decide upon the choice of colors and other finishes when alternates exist. No variation shall be made in colors without the acceptance from the CITY. Color names and/or numbers shall be identified according to the appropriate color chart issued by the manufacturer of the particular product in question.

3.06 COLOR CODING AND LETTERING OF PIPING

- A. The CONTRACTOR shall paint all piping, valves, exposed conduits and all appurtenances which are integral to a complete functional mechanical pipe and electrical conduit system, in accordance with Section 15030 – “Piping and Equipment Identifications”. Where colors are

not designated for piping and conduit systems they will be selected during the shop drawing review from the paint manufacturer's standard color charts.

- END OF SECTION -

DIVISION 10 – SPECIALTIES

SECTION 10400 - IDENTIFYING DEVICES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The CONTRACTOR shall furnish and install all labor, materials, equipment and appliances required for the complete execution of the Work as specified herein.
- B. Principal items of work include:
 - 1. Aluminum outdoor signs
 - 2. Self-adhesive safety labels

1.02 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in Section entitled "Submittals," submit the following:
 - 1. Color and finish samples for all nameplates, and signs.
 - 2. Shop drawings shall include, but not be limited to:
 - a. Complete details for all signs giving sizes and styles of lettering and colors.
 - b. Complete schedules for signs giving location, message, letter, size, color, and method of attachment.
 - c. Details of fabrication and attachment of all items.

1.03 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.

1.04 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with the Specifications, provide aluminum sign products from one of the following manufacturers:
 - 1. Andco Industries Corporation
 - 2. Interface Architectural Signage Incorporated
 - 3. Environmental Sign Systems
 - 4. Lab Safety Supply

PART 2 -- PRODUCTS

2.01 ALUMINUM SIGNS

- A. Signs shall be fabricated from aluminum and suitable for outdoor use.
- B. All safety signs shall comply with the most recent versions of ANSI Z535.2 – *Environmental and Facility Safety Signs* and 29 CFR 1910.145 – *Specification for Accident Prevention Signs and Tags*.

2.02 ACCESSORIES

- A. Mounting Hardware: Stainless steel fasteners, aluminum hardware.

2.03 AMERICANS WITH DISABILITIES ACT COMPLIANCE

- A. All exterior room name signs, interior room name signs, storage signs, temporary signs, emergency escape signs, capacity signs, exit route signs, and toilet room handicapped signs shall comply with the American With Disabilities Act, including but not limited to the character proportion, height, finish, contrast, mounting height and location, symbols Braille, pictograms and raised characters.

2.04 EMERGENCY ESCAPE SIGN

- A. CONTRACTOR shall provide and install signs 1 1/2" high minimum or as required by the American With Disabilities Act x length as required reading "EMERGENCY ESCAPE". Locate next to all door openings to stairways. Exact locations shall be located on site as directed by the ENGINEER.
- B. Material shall be 1/8" clear matte acrylic stock with sub-surface printed red ground and white Helvetica Medium copy. Sign shall have 3/8" radius corners.
- C. Mounting shall be with non-removable head screws using shields where mounted on masonry or concrete surfaces. Mount adjacent to doors.

2.06 EXIT ROUTE SIGNS

- A. CONTRACTOR shall provide and install exit route signs consisting of 10" x 12" minimum or as required by the Americans With Disabilities Act. Use Black anodic architectural aluminum channel frame with metal clips reinforced mitered corners.
- B. The frame shall have a clear matte Plexiglas face and 1/8" tempered hardboard back with four tamperproof screws fastened through hardboard back to wall. Allow for the installation of hard card message between face and back.
- C. Install adjacent to all exit doors as directed on the site by the ENGINEER.

2.07 FIRE EXTINGUISHER SIGNS

- A. CONTRACTOR shall provide and install signs on exterior side of rooms having fire extinguishers in the room. Sign shall have white raised letters chemically fused to 1/8"

red acrylic plastic background. Signs shall be 1 1/2" high x length required reading "FIRE EXTINGUISHER INSIDE". Doors with these signs shall remain unlocked at all times the facility is occupied including nighttime uses.

2.08 SIGN AND LABEL SCHEDULE

- A. CONTRACTOR shall provide and install signs according to the sign and label schedule summarized in Table 10400-1. CONTRACTOR shall provide the signs and labels as listed by Lab Safety Supply product number or equal. CONTRACTOR shall prepare submittals of all custom signs for ENGINEER's review.
- B. CONTRACTOR shall provide signage in addition to signage indicated on Schedule as required to meet all regulatory and building department submittals.

**Table 10400-1
Sign and Label Schedule**

Sign Wording or Type of Sign	Minimum Size (in.) H x W	Type	Lab Safety Supply Reference No.	Quantity	Location
<u>Information Signs</u>					
RAS PUMP STATION NO. 1	24 X 24	Aluminum Sign	Custom	1	At entrance to RAS Pump Station Building

PART 3 -- EXECUTION

3.01 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. Installation shall comply with the applicable handicap accessibility requirements and heights.

3.02 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.

- END OF SECTION -

DIVISION 11 – EQUIPMENT

SECTION 11000 - 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 necessary accessories as specified herein, 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, and other appurtenances as specified, and as may be required for a complete and operating installation.
- C. It is the intent of these Specifications that the CONTRACTOR shall provide the CITY complete and operational equipment/systems. To this end, it is the responsibility of the CONTRACTOR to coordinate all interfaces with 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 intended by the Specifications.
- D. The complete installation shall be free from excessive vibration, cavitation, noise, and oil or water leaks.
- E. The requirements of this section shall apply to equipment furnished under Divisions 11, 13, 14, and 15.

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 01090, Reference Standards.

1.03 PERFORMANCE AFFIDAVITS

- A. When required in the individual equipment Specifications, the CONTRACTOR shall submit manufacturer's Performance Affidavits for equipment to be furnished.
- B. By these affidavits, each manufacturer must certify to the CONTRACTOR and the CITY, jointly, that he has examined the Contract Documents and that the equipment, apparatus, or process he offers to furnish will meet in every way the performance requirements set forth or implied in the Contract Documents.
- C. The CONTRACTOR must transmit to the ENGINEER three (3) original copies of the affidavit given him by the manufacturer or supplier along with the initial Shop Drawing submittals.
- D. The Performance Affidavit must be signed by an officer of the basic corporation, partnership, or company manufacturing the equipment and witnessed by a notary public.

- E. The Performance Affidavit shall have the following format:

Addressed to: (CONTRACTOR) and City of Hollywood (CITY)

Reference: SRWWTP RAS Pump Station No. 2 Replacement

Text: (Manufacturer's Name) has examined the Contract Documents and hereby state that the (Product) meets in every way the performance requirements set forth or implied in Section ____ of the Contract Documents.

Signature: Corporate Officers shall be Vice President, or higher. (Unless statement authorizing signature is attached.)

1.04 SHOP DRAWINGS

- A. Shop Drawings shall be submitted to the ENGINEER for all equipment in accordance with Section 01300, Submittals and shall include the following information in addition to the requirements of Section 01300, Submittals:

1. Performance characteristics and descriptive data.
2. Detailed equipment dimensional drawings and setting plans.
3. General lifting, erection, installation, and adjustment instructions, and recommendations.
4. 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.
5. 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.
6. Details on materials of construction of all components including applicable ASTM designations.
7. Information on bearing types and bearing life.
8. Gear box design and performance criteria and AGMA service factor.
9. Piping schematics.
10. Motor data sheet indicating motor 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 1/2, 3/4 and full load; slip at full load; running, full load, and locked rotor current values; and safe running time-current curves. Refer to Specification Section 16405.

11. Equipment and motor protective device details. Connection diagrams for motor and all protective devices.
12. Equipment shop coating systems, interior and exterior.
13. Panel layout drawings, schematic wiring diagrams, and component product data sheets for control panels.
14. A list of spare parts and special tools to be provided.
15. Any additional information required to show conformance with the equipment specifications.
16. Warranty documentation including statement of duration of warranty period and contact phone numbers and addresses for warranty issues.

B. SHOP DRAWINGS ON ITEMS REQUIRING PERFORMANCE AFFIDAVITS WILL NOT BE REVIEWED UNTIL ACCEPTABLE PERFORMANCE AFFIDAVITS ARE RECEIVED.

1.05 OPERATION AND MAINTENANCE INSTRUCTION/MANUALS

- A. Operation and Maintenance (O&M) manuals shall be submitted in accordance with Section 01300.

1.06 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 both workmanship and materials shall be entirely suitable for the service to which the units are to be subjected 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 ASTM, ASME, AIEE, NEMA, and other generally accepted applicable standards.
- D. All bearings and moving parts shall be adequately protected by bushings or other 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 safety codes of the USA and the State in which the project is located.

- H. All rotating shafts, couplings, or other moving pieces of equipment shall be provided with suitable 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 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 new, of current manufacture, and shall be the products of reputable manufacturers specializing in the manufacture of such products.

1.07 EQUIPMENT WARRANTIES

- A. Warranty requirements may be added to or modified in the individual equipment specifications.
- B. The equipment furnished under this Contract shall be guaranteed to be free from defects in workmanship, design and/or materials for a period of one (1) year unless otherwise specified in the individual equipment specifications. The period of such warranties shall start on the date the particular equipment is placed in use by the CITY with corresponding start-up certification provided by the manufacturer's technical representative as specified herein, provided that the equipment demonstrates satisfactory performance during the thirty day operational period after the equipment startup. If the equipment does not perform satisfactorily during the thirty day operational period, the start of the warranty period will be delayed until the equipment demonstrates proper operation. The Equipment Supplier shall repair or replace without charge to the CITY any part of equipment which is defective or showing undue wear within the guarantee period, or replace the equipment with new equipment if the mechanical performance is unsatisfactory; furnishing all parts, materials, labor, etc., necessary to return the equipment to its specified performance level. Repairs made during the warranty period shall include any required re-balancing.
- C. The CONTRACTOR shall provide an equipment warranty log book prepared specifically for this project and submit two (2) copies of the document to the ENGINEER prior to final payment. The equipment warranty log book shall include a summary listing of all equipment warranties provided, date received, and start date and end date of warranty period. A copy of each equipment warranty and equipment start-up certification shall also be provided in the document.
- D. The Equipment Supplier shall guarantee to the CITY that all equipment offered under these specifications, or that any process resulting from the use of such equipment in the manner stated is not the subject of patent litigation, and that he has not knowingly offered equipment, the installation or use of which is likely to result in a patent controversy, in which the CITY as user is likely to be made the defendant.
- E. Where patent infringements are likely to occur, each Equipment Supplier shall submit, as a part of his bid, license arrangements between himself, or the manufacturer of the equipment offered, and the patent CITY or the controller of the patent, which will permit the use in the specified manner of such mechanical equipment as he may be bidding.

- F. Each Equipment Supplier, by submitting his bid, agrees to hold and save the CITY and ENGINEER or its officers, agents, servants, and employees harmless from liability of any nature or kind, including cost and expenses for, or on account of, any patented or unpatented invention, process, article, or appliance manufactured or used in the performance of the work under this contract, including the use of the same by the CITY.

PART 2 -- PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. The materials covered by these Specifications are intended to be equipment of proven reliability, and as manufactured by reputable manufacturers having experience in the production of such equipment. The CONTRACTOR shall, upon request of the ENGINEER, furnish the names of not less than 5 successful installations of the manufacturer's equipment of the same size and model of that offered under this contract. The equipment furnished shall be designed, constructed, and installed in accordance with the industry accepted practices and shall operate satisfactorily when installed as shown on the Drawings and operated per manufacturer's recommendations.

2.02 ANCHORS AND SUPPORTS

- A. 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 suitable templates shall be used by the CONTRACTOR when required in the detailed equipment Specifications.
- B. Anchor bolts and fasteners shall be furnished in accordance with Section 05050, Metal Fastening, and with the individual equipment Specifications. All anchor bolts shall be a minimum of 1/2-inch diameter. All anchor bolts, handrail bolts, washers, clips, clamps, and fasteners of any type shall be constructed of 316 stainless steel, unless otherwise specified in the individual equipment Specifications.
- C. The CONTRACTOR shall provide all concrete pads or pedestals required for equipment furnished. All concrete equipment pads shall be a minimum of 6" high, unless otherwise shown on the Drawings and shall be doweled.
- D. Pipe sleeves or other means of adjusting anchor bolts shall be provided where indicated or required. 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 non-shrink grout, unless alternate methods are recommended by the manufacturer and are acceptable to the ENGINEER (such as shim leveling pumps, or chemical grout). Non-shrink grout shall be as specified in Section 03315 - Grout.

2.03 STRUCTURAL STEEL

- A. Structural steel used for fabricating equipment shall conform to the requirements of Division 5.

- 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.

2.04 DISSIMILAR METALS

- A. All dissimilar metals shall be properly isolated to the satisfaction of the ENGINEER.

2.05 GALVANIZING

- A. Where required by the equipment specifications, galvanizing shall be performed in accordance with Division 5.

2.06 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.

2.07 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 16 specifications and the latest National Electric Code.
- B. Motors shall conform to the applicable requirements of Section 16040, Electric Motors.
- C. 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 CITY.
- D. 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 16 and shall be as specified in Section 16435, Variable Frequency Drive Systems.
- E. Motor starters and controls shall be furnished and installed under Division 16 and Division 17 unless otherwise specified in the individual pump specifications.

2.08 ACCESSORIES, SPARE PARTS, AND SPECIAL TOOLS

- A. Spare parts for equipment shall be furnished where indicated in the equipment Specifications or where recommended by the equipment manufacturer.
- B. Spare parts shall be identical and interchangeable with original parts.
- C. The 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.

- D. Painting requirements for spare parts shall be identical to those for original, installed parts. Where no painting or protective coating is specified, suitable provisions shall be made to protect against corrosion.
- E. Spare parts shall be delivered at the same time as the equipment to which they pertain. Spare parts shall be stored separately in a locked area, maintained by the CONTRACTOR, and shall be turned over to the CITY in a group prior to substantial completion. All of these materials shall be properly packed, labeled, and stored where directed by the CITY and ENGINEER.
- F. The CONTRACTOR shall furnish all special tools necessary to operate, disassemble, service, repair, and adjust the equipment in accordance with the manufacturers operation and maintenance manual.
- G. The CONTRACTOR shall furnish a one year supply of all recommended lubricating oils and greases. The manufacturer shall submit a list of at least four manufacturer's standard lubricants which may be used interchangeably for each type of lubricant required. All of these materials shall be properly packed, labeled and stored where directed by the ENGINEER.

2.09 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 the manufacturer's name, year of manufacture, serial number, and principal rating data.
- B. All equipment provided under Divisions 11 through 15 including motorized and manual gates and valves (aboveground and buried) shall also be identified as to the equipment name and equipment tag number by a suitable laminated plastic or stainless steel nameplate mechanically fastened with stainless steel hardware; for example, "Mechanical Bar Screen No. 1: MBS 01001". Equipment names and equipment tag numbers shall match the names provided for the equipment as identified on the Drawings and in the Specifications. Equipment names and tag numbers not currently identified in the Drawings and Specifications shall be provided to the CONTRACTOR prior to the fabrication of the nameplates. Coordinate name and number with same on remotely located controls, control panel, and other related equipment. For buried valve applications, the valve name and number shall be included in the bronze disc embedded in the valve's concrete collar as identified on the Drawings.
- 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 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. Five (5) certified copies 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 CITY/ENGINEER to witness performance tests in the manufacturer's shop. The ENGINEER shall be notified ten working days before shop testing commences.
- E. Shop testing of electric motors shall be in accordance with applicable requirements of Section 16040, Electric Motors and Section 16000, Basic Electrical Requirements.

3.02 STORAGE OF EQUIPMENT AND MATERIALS

- A. CONTRACTOR shall store his equipment and materials at the job site in strict accordance with the manufacturer's recommendations and as directed by the CITY or ENGINEER, and in conformity to applicable statutes, ordinances, regulations, and rulings of the public authority having jurisdiction. Equipment and materials shall not be delivered to the site prior to 90 days in advance of the scheduled installation. Partial payment requests will not be processed for materials delivered prior to 90 days before installation or for materials that are not properly stored.
- B. Material or equipment stored on the job site is stored at the CONTRACTOR's risk. Any damage sustained of whatever nature shall be repaired to the ENGINEER's satisfaction at no expense to the CITY. Stored electrical equipment is to be protected from the elements and shall have space heaters energized.
- C. CONTRACTOR shall not store unnecessary materials or equipment on the job site and shall take care to prevent any structure from being loaded with a weight which will endanger its security or the safety of persons.
- D. CONTRACTOR shall observe all regulatory signs for loadings on structures, fire safety, and smoking areas.
- E. CONTRACTOR shall not store materials or encroach upon private property without the written consent of the owner of such private property.

3.03 MANUFACTURER'S FIELD SERVICES

- A. The CONTRACTOR shall arrange for a qualified 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 CITY. 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.

- B. For each site visit, the Technical Representative shall submit jointly to the CITY, the ENGINEER, and the CONTRACTOR a complete signed report of the results of his 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.
- C. 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. In the event that 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 CITY. 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: The Technical Representative shall instruct the CITY's operating personnel in correct operation and maintenance procedures. The instruction shall demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment. Such instruction shall be scheduled at a time arranged with the CITY at least 2 weeks in advance of the training and shall be provided while the respective Technical Representative's equipment is fully operational. The CONTRACTOR shall submit an Agenda for approval prior to scheduling. The CONTRACTOR shall have submitted, and had accepted, the O&M Manuals prior to commencement of training. Training shall be provided to four separate shifts of the CITY's personnel between the hours of 6:00 A.M. and 6:00 P.M. as necessary. The CONTRACTOR shall provide professional video recordings of all training sessions. Completed, labeled recordings shall be provided to the CITY for each type of training session.
 5. Services after Startup: Where required by the individual equipment specifications, the Technical Representative shall return to the project site thirty (30) days after the

start up date to review the equipment performance, correct any equipment problems, and conduct operation and maintenance classes as required by the CITY.

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 CITY in writing that his 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 CITY until the problems are corrected and the equipment demonstrates a successful thirty (30) days operating period.

- D. Services of the Technical Representative will require a minimum of two (2) 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.
- E. 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.
- F. The CONTRACTOR shall notify the ENGINEER at least 14 days in advance of each equipment test or CITY training session.
- G. The Technical Representative shall sign in and out at the office of the ENGINEER's Resident Project Representative on each day he 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 the ENGINEER's field representative one week prior to installation.
- B. The CONTRACTOR shall have on hand sufficient personnel, proper construction equipment, and machinery of ample capacity to facilitate the work and to handle all emergencies normally encountered in work of this character. To minimize field erection problems, mechanical units shall be factory-assembled insofar as practical.
- C. Equipment shall be erected in a neat and workmanlike manner on the foundations at the locations and elevations shown on the Drawings.
- D. All equipment sections and loose items shall be match-marked prior to shipping.
- E. For equipment such as pumping units, which require field alignment and connections, the CONTRACTOR shall provide the services of the manufacturer's qualified mechanic, millwright, or machinist, to align the pump and motor prior to making piping connections or anchoring the pump base. Alignment shall be as specified herein.

- 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.

3.05 ALIGNMENT

- A. Set equipment to dimensions shown on drawings. Dimensions shall be accurate to $\pm 1/16$ inch unless otherwise noted on the drawings. Wedges shall not be used for leveling, aligning, or supporting equipment.
- B. General Equipment Leveling: Non-rotating equipment shall be set level to $\pm 1/16$ inch per 10 foot length (.005 inch per foot) unless otherwise noted on the drawings. Shims shall be used unless equipment is furnished with leveling feet. Set shims flush with equipment baseplate 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.
- C. Grouting
 - 1. Fill anchor bolt holes or sleeves with grout, after bolt alignment is proven, and prior to placing grout under equipment bases.
 - 2. Surface Preparation. Roughen surface by chipping, removing laitance, and unsound concrete. Clean area of all foreign material such as oil, grease, and scale. Saturate area with water at least 4 hours prior to grouting, removing excess water ponds.
 - 3. Application. Place grout after the equipment base has been set and its alignment and level have been approved. Form around the base, mix grout, and place in accordance with the grout manufacturers published instructions. Eliminate all air or water pockets beneath the base using a drag chain or rope.
 - 4. Finishing. Point the edges of the grout to form a smooth 45 degree slope.
 - 5. After grout has cured (not before 3 days after placement) paint exposed surfaces of grout with shellac.
 - 6. Level Verification. After grout has cured, and immediately prior to drive alignment, recheck equipment for level and plumb. Re-level and square as necessary. Hold final checks for inspection and approval by ENGINEER.
- D. Inspect for and remove all machining burrs or thread pulls in female holes on mating surfaces of mounting frame and machine feet.
- E. Inspect and clean equipment mounting base pads, feet, and frames to remove all grease, rust, paint and dirt.
- F. Assembled equipment shafts shall be set level to .0015 inches per foot of shaft length ($\pm .0005$ inches) up to a maximum of 0.015 inches for any length shaft unless the manufacturers requirements are more stringent or unless otherwise noted in the equipment specifications. Use the machined surfaces on which the equipment sets for the

base/mounting frame leveling plane. Use the machined shaft surface for equipment leveling plane.

- G. Sprocket and Sheave Alignment. Check shaft mounted components for face runout and eccentricity (outside diameter) runout by magnetically mounting a dial indicator on a stationary base and indicating over 360 degrees on a continuous machined surface at the outside diameter of the component. Maximum allowable total indicated face runout and eccentricity for sprockets and sheaves will be per ANSI Standard B29.1-1975.
- H. Belt tensioning. Set drive belt tension to manufacturer's specification for the belt type. Recheck alignment after drive tensioning.
- I. Thermal/Mechanical Growth. Thermal/mechanical growth corrections for driver and driven machines will be used in vertical and horizontal alignment where applicable. The equipment manufacturer will determine thermal/mechanical growth applicability for any machine and provide the correction offsets to be used.
- J. Rotating Shaft Alignment
 - 1. Fixtures will be set up on the driver and driven machine, machines shaft surfaces. Machined coupling hubs may be used only if there is no clearance to mount fixtures directly on the shafts.
 - 2. Primary alignment method for direct drive machines is when coupled. Uncoupled alignment will be used only when approved by the ENGINEER.
 - 3. Account for possible coupling flex by always rotating coupled machines in the same direction during alignment.
 - 4. Uncoupled machines must be connected so that both shafts turn together without relative motion during alignment.
 - 5. Indicator bar sag will be measured and included for each reverse indicator alignment setup.
 - 6. Reverse Dial Indicator. The final maximum allowable misalignment: vertical and horizontal from the desired targets of .000 inches (for a non-thermal growth machine) or from the given target readings (for a thermal growth machine) must meet BOTH of the following conditions simultaneously: 1/2 the final total indicator reading at each indicator will be no more than shown in the table below AND the final remaining correction at each machine foot be no more than .001 inches of required movement.

Machine Speed (RPM)	Total Misalignment* (inches)
Up to 1800	.002
1800 and greater	.001

**1/2 indicator reading*

3.06 FIELD TESTING

A. 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.

B. 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 manufacturer's 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 his 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.

C. 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 his assigned representative and the CITY or his 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 as specified herein.
 - b. Check motor current draw under load conditions. The rated motor nameplate current shall not be exceeded.

- c. Recheck alignment with dial indicators where applicable, after unit has run under load for a minimum of 24 hours.
- D. In addition to the above described field tests, any other tests specifically required by Division 11, the individual equipment Specifications, or by the manufacturer shall be performed.
- E. 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 CITY.
- F. 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.
- G. Defects which cannot be corrected by installation adjustments will be sufficient grounds for rejection of any equipment.
- H. 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 CITY unless otherwise specified in the individual equipment specifications.
- I. 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 CITY formally takes over the operation thereof.
- J. Field testing of electric motors shall be in accordance with Division 16.

3.07 VIBRATION TESTING

- A. Unless specified otherwise in the detailed equipment specifications, each pump, blower, compressor, motor or similar item of stationary rotating equipment having a rated power in excess of 40HP shall be tested after installation for acceptable vibration levels.
- B. Vibration testing shall be performed by an experienced factory-trained and authorized third-party analysis expert (not a sales representative) retained by the CONTRACTOR and approved by the ENGINEER. 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 four (4) certified copies of vibration test data for each test performed.
- C. For systems with variable speed drives, tests shall be conducted at various speeds between maximum and minimum. For systems with two-speed drives, tests shall be conducted at both speeds. For systems with constant-speed drive, tests shall be conducted under various loading conditions as determined by the ENGINEER.
- D. All field vibration tests shall be performed with the equipment operating on the product for which it is intended, or a substitute acceptable to the ENGINEER.

- E. The term 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 G's. Displacement and velocity shall be measured by suitable equipment equal to IRD Mechanical, Bentley, Nevada.
- E. Frequency of vibration, in cycles per minute (cpm), shall be determined when vibration exceeds specified levels or as otherwise necessary. Vibration shall be measured on the bearing housing, unless other locations are deemed necessary by the vibration analysis expert and ENGINEER.
- F. For all equipment tested, vibration shall be checked in the radial and axial directions. 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.
- G. Copies of test results shall be submitted to the ENGINEER for review. Should the vibration field test results exceed shop test results, the manufacturer's recommendations, or the limits specified herein, the CONTRACTOR shall correct the deficiencies within thirty (30) days. After corrections have been completed, the vibration testing shall be re-run and the results re-submitted to the ENGINEER for review.
- H. Noise or vibration in any rotating equipment which the ENGINEER determines to be excessive or damaging and falls outside of the acceptable limits for that particular piece of equipment, shall be cause for rejection.

3.08 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 CITY, notwithstanding his 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 CITY, adjust the contract price to reflect not supplying the specific equipment item.
- D. In case the CITY rejects said equipment, then the CONTRACTOR hereby agrees to repay to the CITY 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 CITY will execute and deliver to the CONTRACTOR a bill of sale of all his rights, title, and interest in and to said rejected equipment; provided, however, that said equipment shall not be removed from the premises until the CITY obtains from other sources other equipment to take the place of that rejected.

- F. Said bill of sale shall not abrogate CITY's right to recover damages for delays, losses, or other conditions arising out of the basic contract.

3.09 PAINTING

- A. All surface preparation, shop painting, field repairs, finish painting, and other pertinent detailed painting specifications shall conform to applicable sections of Section 09900, 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. The equipment and motor shall be painted with a high quality epoxy polyamide semi-gloss coating specifically resistant to chemical, solvent, moisture, and acid environmental conditions, unless otherwise specified.
- 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.

3.10 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.

- END OF SECTION -

SECTION 11100 - PUMPS, GENERAL

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The CONTRACTOR shall furnish and install all tools, supplies, materials, equipment and labor necessary for the installation, testing, and placing into operation of all pumps and pumping appurtenances, complete and operable, all in accordance with the requirements of the Contract Documents.
- B. All pumping equipment shall be provided in accordance with the requirements of Section 11000, Equipment General Provisions.
- C. The provisions of this Section shall apply to all pumps and pumping equipment specified, except where otherwise specified in the Contract Documents.
- D. The CONTRACTOR, through a single Supplier, shall have unit responsibility for the furnishing and functional operation of a given type of complete pump systems including the pumps, drives, drive motors, speed control equipment (where variable speed drives are required) and accessories. The designated single Supplier, however, need not manufacture more than one part of the unit (pump, or motor and drive), but shall coordinate the design, assembly, testing, and erection of the unit(s) as specified herein.
- E. The pumps shall be provided complete with all accessories, shims, sheaves, couplings, and other appurtenances as specified, as as may be required for a complete and operating installation.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 01300 – Submittals
- B. Section 05500 – Metal Fabrications
- C. Section 09900 – Painting
- D. Section 11000 – Equipment General Provisions
- E. Section 15000 – Basic Mechanical Requirements
- F. Section 16000 – Basic Electrical Requirements
- G. Section 16040 – Electric Motors
- H. Section 16435 - Variable Frequency Drive Systems

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Codes: The Building Code, as referenced herein, shall be the Florida Building Code (FBC), as specified in Section 01090, Reference Standards.

B. Commercial Standards: Pumping system equipment, installation and testing shall be in accordance with the following applicable codes and standards:

1. Hydraulic Institute
 - a. ANSI/HI 1.1-1.2-2008 Centrifugal Nomenclature
 - b. ANSI/HI 1.3-2009 Rotodynamic Pumps for Design and Application
 - c. ANSI/ HI 2.1-2.2-2008 American National Standard for Vertical Pumps for Nomenclature and Definitions
 - d. ANSI/HI 3.1-3.5-2008 American National Standard for Rotary Pumps for Nomenclature, Definitions and Operation
 - e. ANSI/HI 3.6 American National Standard for Rotary Pump Tests
 - f. ANSI/HI 9.6.2 American National Standard for Centrifugal and Vertical Pumps Allowable Nozzle Loads
 - g. ANSI/HI 9.6.4-2009 Centrifugal and Vertical Pumps - Vibration Measurements and Allowable Values
 - h. ANSI/HI 9.6.6-2009 Rotodynamic Pumps for Pump Piping
 - i. ANSI/HI 9.8-1998 American National Standard for Centrifugal and Vertical Pump Intake Design
 - j. ANSI/HI 11.6-2001 Submersible Pump Tests
 - k. ANSI/HI 12.1-12.6 Rotodynamic Slurry Pump Standard
 - l. ANSI/HI 14.6 Rotodynamic Pumps for Hydraulic Performance Acceptance Tests
2. American Society of Mechanical Engineers
 - a. ANSI/ASME B73.1 Specifications for Horizontal End Suction Centrifugal Pumps for Chemical Process
3. American Petroleum Institute
 - a. ANSI/API Standard 610 Centrifugal Pumps for Petroleum, Petrochemical and Natural Gas Industries
4. American Water Works Association
 - a. ANSI/AWWA E103 Standard for Horizontal and Vertical Line-Shaft Pumps
5. American Society for Testing and Materials
 - a. A36 Specification for Structural Steel
 - b. A48 Specification for Gray Iron Castings
 - c. A53 Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
 - d. A148 Specification for Steel Castings, High Strength, for Structural Purposes
 - e. A193 Specification for Alloy Steel and Stainless Steel Bolting Materials for High Temperature Service
 - f. A276 Specification for Stainless Steel Hot/Cold-Finished Bars
 - g. A322 Specification for Steel Bars, Alloy, Standard Grades
 - h. A514 Specification for High Yield Strength, Quenched and Tempered alloy Steel Plate, Suitable for Welding
 - i. A532 Specification for Abrasion-Resistant Cast Irons

- j. A536 Specification for Ductile Iron Castings
 - k. A565 Specification for Martensitic Stainless Steel Bars
 - l. A582 Specification for Free-Machining Stainless and Heat-Resisting Steel Bar, Hot-Rolled and Cold-Rolled
 - m. A743 Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel and Nickel-Base, Corrosion-Resistant for General Application
 - n. B148 Specification for Aluminum-Bronze Sand Castings
 - o. B584 Specification for Copper Alloy Sand Castings for General Application
- 6. American National Standards Institute
 - a. B16.1 Standard for Cast Iron Pipe Flanges and Flanged Fittings
 - b. B16.5 Standard for Pipe Flanges and Flanged Fittings
 - 7. ANSI/NFPA 70 National Electric Code
 - 8. Society of Automotive Engineers SAE J404 Chemical Compositions of SAE Alloy Steels

1.04 CONTRACTOR SUBMITTALS

- A. Shop Drawings: Shop drawings of all pumps shall include the following information in addition to the requirements of Section 01300, Submittals and Section 11000, Equipment General Provisions.
 - 1. Pump name, identification number and specification number.
 - 2. Performance curve and pump data.
 - 3. Pump hydraulic characteristic curves, efficiencies, required net positive suction head (NPSH), and horsepower curves at pump rotative speeds corresponding to the conditions specified. For variable speed driven pumps, curves shall be submitted at minimum, intermediate and maximum operating speed as well as for operation with the variable speed drive bypassed (across the line). The CONTRACTOR shall require the manufacturer to indicate points on the H/Q curves, and the limits recommended for stable operation between which the pumps may be operated without surge, cavitation, overheating, recirculation, and vibration. The stable operating range shall be as wide as possible based on actual hydraulic and mechanical tests. Motors and drives shall be furnished so that they are non-overloaded throughout the entire stable operating range of the pump. The use of service factors in this determination will not be allowed.
 - 4. Details of shaft sealing system.
 - 5. General cutaway sections, materials, dimension of shaft projections, shaft and keyway dimensions, shaft diameter, dimension between bearings, general dimensions of pump, suction head bolt orientation, design or baseplate, and anchor bolt locations and forces.
 - 6. Electrical data including control and wiring diagrams.

7. Pump drive and motor data in accordance with Division 16 Electrical, of these documents.
 8. Uncrated weight of the pump, weight of heaviest part of pump.
 9. Foundry certificates and results of Brinnell hardness testing showing compliance to ASTM A 532. Each individual casting shall be Brinnell tested in a minimum of two places, in an area of representative casting thickness to ASTM Method E-10. Results shall be certified by a registered professional Engineer. Test results shall verify the satisfaction of the required Brinnell hardness of the finished product as specified in respective subsections.
 10. Where pump 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 pump, motor and variable speed drive shop drawings together as a complete system.
 11. Submersible pump submittals shall also include:
 - a. Product data sheets for power and control cables and length of cables.
 - b. Details on pump guide rail system and mounting requirements.
- B. Certification: The CONTRACTOR shall obtain written certification from the pump manufacturer, stating that the equipment will efficiently and thoroughly perform the required functions in accordance with these Specifications and as indicated on the Drawings, CONTRACTOR shall have unit responsibility for coordination of all equipment, including motors, variable speed drives, controls, and services required for proper installation and operation of the completely assembled and installed pumps. The CONTRACTOR shall submit all such certificates to the ENGINEER.
- C. O & M Manuals: Prior to start-up the CONTRACTOR shall furnish complete operations and maintenance manuals in accordance with Section 01300, Submittals and Section 11000, Equipment General Provisions. Pump O&M Manuals shall include the performance curves and pump data.
- D. Spare Parts: The CONTRACTOR shall obtain from the pump manufacturer a set of the specified herein spare parts of all items of each pump, motor, and drive, subject to wear, such as seals, packing, gaskets, nuts, bolts, washers, wear rings, etc., as well as a set of spare bearings. It shall furnish all these parts suitably packaged and labeled with the part number, manufacturer's description, and the associated equipment number described above for tools. Required spare parts shall be as specified in individual section of the specification. If not listed there, then spare parts shall conform to the standards of the proposed supplier.
- E. Maintenance: Printed instructions relating to proper maintenance, including lubrication, and parts lists indicating the various parts by name, number, and diagram where necessary, shall be furnished in duplicate with each unit or set of identical units in each pumping station. A recommended spare parts list shall be included.

- F. Field Procedures: Instructions for field procedures for erection, adjustments, inspection, and testing shall be provided with the shop drawings.

1.05 QUALITY ASSURANCE

- A. Performance Curves: All centrifugal pumps shall have a continuously rising curve. In no case shall the required horsepower at any point on the performance curve exceed the rated horsepower of the motor or drive. Safety factors will not be considered in determining compliance with this requirement.
- B. Testing: CONTRACTOR shall be responsible for the coordination of factory and field tests as required in Part 3 of this section.

1.06 MANUFACTURER'S SERVICE REPRESENTATIVE

- A. Unless otherwise referenced in the individual equipment specification section, as a minimum the services of the manufacturer's representative shall be provided for a period as stated in the following schedule:

Installation Trip (days)	Operation Trip Days*	Guaranteed Period Trip (days)
2	2	1

- B. Any additional time required to achieve successful installation and operation shall be at the expense of the CONTRACTOR.

1.07 CLEANUP

- A. After completion of the installation and testing, the CONTRACTOR shall remove all debris from the site, clean all the pumping equipment and controls, and hand over its work in perfect operating condition.

1.08 GUARANTEES, WARRANTIES

- A. After completion, the CONTRACTOR shall furnish to the OWNER the manufacturer's written guarantees that the pumping equipment will operate with the published efficiencies, heads, and flow ranges and meet these Specifications. The CONTRACTOR shall also furnish the manufacturer's warranties as published in its literature and as specified in Section 11000, Equipment General Provisions.

PART 2 -- PRODUCTS

2.01 GENERAL

- A. Wherever it is specified that a single Supplier shall be responsible for the compatible and successful operation of the various components of any pumping equipment, it shall be understood to mean that the CONTRACTOR shall furnish and install only such pumping equipment as the designated single Supplier will certify is suitable for use with its equipment and with the further understanding that this in no way constitutes a waiver of any specified requirements.
- B. All combinations of manufactured equipment which are provided under these Specifications shall be entirely compatible, and the CONTRACTOR shall be responsible for the compatible and successful operation of the various components of the units conforming to specified requirements. Each unit of pumping equipment shall incorporate all basic mechanisms, coupling, electric motor or engine drive and unit mounting. All necessary mountings and appurtenances shall be included.
- C. Where two or more units of the same type and/or size of pumping equipment are required, such units shall all be produced by the same manufacturer.

2.02 MATERIALS

- A. All materials employed in the pumping equipment shall be suitable for the intended application; 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, and shall conform to the following requirements unless otherwise specified in individual pumping equipment Specifications:
 - 1. Cast iron pump casings and bowls shall be of close-grained gray cast iron, conforming to ASTM A 48, or equal.
 - 2. Bronze pump impellers shall conform to ASTM B584, "G Bronze".
 - 3. Stainless steel pump shafts shall be of Type 400, Series. Miscellaneous stainless steel parts shall be of Type 316
 - 4. All anchor bolts, nuts and washers shall be Type 316 stainless steel, unless otherwise specified in individual pumping equipment Specifications.

2.03 PUMP APPURTENANCES

- A. Nameplates: In addition to the requirements of Section 11000, Equipment General Provisions, nameplate data for each pump shall include the rating in gallons per minute, rated head, speed, and efficiency at the primary design point..
- B. Solenoid Valves: Where required, the pump manufacturer shall furnish and install solenoid valves on the water or oil lubrication lines. Solenoid valve electrical rating shall be compatible with the motor control voltage and shall be furnished complete with all necessary conduit and wiring installation from control panel to solenoid.
- C. Pressure Gages: The Contractor shall furnish and install pressure gauges on the suction and discharge of each pump, except wet-pit submersible pumps and vertical turbine pumps. The Contractor shall furnish and install pressure gauges on the discharge piping of each

wet pit submersible pump and vertical turbine pump in the locations shown on the Drawings or as directed by the Engineer. Pressure gages shall be located in a representative location, where not subject to shock or vibrations, in order to achieve true and accurate readings. Pressure gages shall be furnished under Division 17, Instrumentation, of these documents.

- D. Variable Speed Drives: Variable speed drives, drive motors, speed control equipment, and accessories shall be furnished in accordance with Division 16, Electrical, of these documents.

2.04 PUMP REQUIREMENTS - GENERAL

- A. Flanges: Suction and discharge flanges shall conform to ASME B16.1 or B16.5 dimensions.
- B. Handholes: Handholes on pump casings shall be shaped to follow the contours of the casing to avoid any obstructions in the water passage.
- C. Mechanical Seals: Mechanical seal designs shall be selected for highest reliability and for rugged service. Mechanical seals shall be provided where required by the Specifications. Unless the pump manufacturer recommends better seal for a specific application, mechanical seals shall be furnished as specified in individual pumping equipment sections.
- D. For all seal arrangements, seals must be flushed by the pumped fluid or externally supplied liquid as indicated by individual pumping equipment specifications or as required by manufacturer, in order to maintain reliable seal performance.
- E. All drivers and shafting shall comply with the requirements of Section 01600, "Materials and Equipment" of the specification.
- F. Drive shaft and bearing assemblies shall be sized such that critical speed conforms to the following requirements:
 - 1. For constant speed pumps, operating speed shall not be more than 75 percent of critical speed, nor within the range of 44 percent to 56 percent of critical speed for horizontal shafts.
 - 2. For variable speed pumps, full speed shall not be more than 44 percent of critical speed for horizontal shafts or 75 percent of critical speed for vertical shafts.
- G. All shafting shall be dynamically balanced in accordance with the recommendations of the shafting manufacturer.
- H. Drive shaft dimensions and, where applicable, the location of steady bearing supports are shown approximately to scale on the drawings. Exact dimensions and support arrangements will depend on the motor and pump which the CONTRACTOR proposed to install. The CONTRACTOR shall submit complete shop drawings and Specifications to the ENGINEER for review of the drive shaft arrangement proposed.
- I. The drive shaft manufacturer shall furnish to the CONTRACTOR complete installation instructions for the equipment furnished. The CONTRACTOR shall install the drive shaft

assemblies per the manufacturer's instructions. The shafts shall be installed with a minimum of one degree offset and a maximum of five degrees offset at each universal joint.

- J. The CONTRACTOR shall furnish and install a heavy-duty shaft guard for all drive shafting which is less than seven feet above floor or platform level in accordance with the provisions of Paragraph 1910.210 of OSHA Rules and Regulations. Provision shall be made in the guard as necessary for lubrication and inspection access of the joints and bearings without the necessity of removing the entire guard assembly.
- K. The minimum ABMA L10 bearing life for all pump, motor and drive bearings shall be 60,000 hours unless otherwise stated in the individual equipment specification sections.

PART 3 -- EXECUTION

3.01 INSTALLATION

- A. General: Pumping equipment shall be installed in accordance with the manufacturer's recommendations, industry accepted practices, acceptable procedures submitted with the shop drawings and as indicated on the Drawings, unless otherwise accepted by the ENGINEER.
- B. Alignment: Equipment shall be field tested to verify proper alignment, operation as specified, and freedom from binding, scraping, vibration, shaft runout, or other defects. Pump drive shafts shall be measured just prior to assembly to ensure correct alignment without forcing. Equipment shall be secure in position and neat in appearance.
- C. Lubricants: The installation work shall include furnishing the necessary oil and grease for initial operation.
- D. Connections: All motors shall be connected to the conduit system by means of a short section (18-inch minimum) of weatherproof flexible conduit, unless otherwise indicated. For connections for No. 6 AWG and smaller wire size, the CONTRACTOR shall furnish flexible conduit with an acceptable grounding conductor inside the flexible section. For connections of No. 4 AWG or larger wire size, the CONTRACTOR shall install a grounding conduction in the conduit and terminate at the motor control center with an acceptable grounding clamp.
- E. Drains: All gland seals, air valves, and drains shall be piped to the nearest floor sink or drain with galvanized steel pipe or copper tube, properly supported with brackets.

3.02 TESTING

- A. Factory Testing: The CONTRACTOR shall be responsible for the coordination of the following tests of each pump, drive, and motor. Pump tests shall utilize the actual motors and pump-motor bases to be furnished with the pumping equipment. Use of the pump manufacturers standard test motors is not acceptable.
 - 1. General: Tests shall be performed in accordance with the Standards of the Hydraulic Institute, Inc. Tests shall be performed on the actual assembled unit. Prototype model tests will not be acceptable. Pump shop tests shall be made by the

manufacturer and certified curves shall be submitted prior to witnessed tests. The shop tests shall consist of standard IEEE tests of motors, operation of the pumps and motors installed on the actual pump and motor bases to be furnished for proper balance of equipment and all other requirements as specified under this section. Pumps motors and drives shall be factory witness tested, as defined herein. All electronic transducers, meters, gauges, and test instruments shall be calibrated within 30 days prior to the scheduled test and certified calibration data shall be provided. Differential pressure type flow meters, such as venturis are preferred and shall have been calibrated, and their accuracy certified within the past 12 months. In case of failure of any unit to meet the test requirements, the manufacturer shall make such alterations as are necessary, and the tests shall be repeated without additional cost to the OWNER until the equipment test is passed.

2. Factory Witnessed Tests: All pumps and motors, 150 horsepower and larger and any smaller pumps, as determined by the ENGINEER, shall be factory-tested as complete, assembled units, as specified above, and witnessed by a representative of the ENGINEER and OWNER. The CONTRACTOR shall give the ENGINEER and OWNER a minimum of two weeks notification prior to the test.
3. Certified Test Data: Factory test results shall be submitted to the ENGINEER in accordance with Section 01300, Submittals. No equipment shall be shipped until the test data is acceptable to the ENGINEER. Acceptance tolerances shall be in accordance with ANSI/HI 14.6 grade 1E for the design point and grade 3B for other points unless otherwise stated in the individual equipment specification sections. Tests shall include those listed below. The applicable best standard for submersible sump and non-clog pumps shall be ANSI / HI 11-6 Submersible Pump Test.
4. Hydrostatic Tests: Hydrostatic tests should be carried out in accordance with ANSI/ Hydraulic Institute Standard 14.6 at 130% of the rated pressure. Rated pressure shall be the maximum operating suction pressure plus the pump differential pressure at the design point. Pumps with plastic casings shall be tested at 110% of the rated pressure.
5. Hydraulic Performance Test: Test shall be at rated full speed with a minimum of 10 readings between shutoff head and 25-percent above design capacity including the specified operating conditions of head and capacity, recorded on data sheets as defined by the Hydraulic Institute, signed, dated, and certified. Certified pump tests shall be conducted through the specified range of flow vs./head/capacity/efficiency curves plotted at pump design speed prior to connection to variable speed drive control systems (where provided). During each test, the pump shall be run at each head/capacity condition as specified in the pump schedule for sufficient time to accurately determine and record capacity, head, pump speed, drawn horsepower, pump efficiency and motor efficiency. Where the pump application requires variable speed, the above tests shall be repeated at 90 percent, 80 percent and 65 percent of full speed. A minimum of 5 readings are required at each test speed.
6. NPSH Tests: Where required by the individual equipment specification sections, NPSH tests shall be conducted to demonstrate satisfactory operation with the specified available NPSH.

- B. Field Tests: All pumping units shall be field tested after installation, in accordance with the Contract Documents, to demonstrate satisfactory operation, without causing excessive noise, vibration, cavitation, and overheating of the bearings. The field testing shall be performed in the presence of an experienced field representative of the manufacturer of each major item of equipment, who shall supervise the following tasks and shall certify in writing that the equipment and controls have been properly installed, aligned, lubricated, adjusted, and readied for operation:
1. Start-up: Start-up, check, and operate the equipment over the entire speed range. The vibration shall be within the amplitude limits recommended in the Hydraulic Institute Standards and it shall be recorded at a minimum of four pumping conditions defined by the ENGINEER.
 2. Performance: Pump performance shall be documented by obtaining concurrent readings, showing motor voltage, amperage, pump suction head, and pump discharge head, for at least four pumping conditions at each pump rpm. Each power lead to the motor shall be checked for proper current balance. Flow shall be measured to the extent possible by permanently installed instrumentation or drawdown measurement.
 3. Bearing Temperatures: Bearing temperatures shall be determined by a contact-type thermometer. A running time of at least 20 minutes shall be maintained for this test, unless liquid volume available is insufficient for a complete test.
 4. Natural-Frequency: Natural frequency testing of each installed vertical turbine pump assembly using the "bump test" method.
 5. Vibration: Operate the equipment over the entire speed range. The vibration shall be within the limits of ANSI/HI 9.6.4 for field testing and it shall be recorded at a minimum of 4 pumping conditions defined by the OWNER's representative.
 6. Certification: The field testing shall be witnessed by the OWNER or its representative. The CONTRACTOR shall submit to the ENGINEER a written notification of all pump field tests a minimum of one week prior to testing. In the event any of the pumping equipment fails to meet the above test requirements, it shall be modified and retested in accordance with the requirements of these Specifications. The CONTRACTOR shall then certify in writing that the equipment has been satisfactorily tested, and that all final adjustments thereto have been made. Certification shall include date of final acceptance test, as well as a listing of all persons present during tests, and resulting test data. The costs of all Work performed in this Paragraph by factory-trained representatives shall be borne by the CONTRACTOR.
 7. Acceptance: In the event of failure of any pump to meet any of the above requirements or efficiencies, the CONTRACTOR shall make all necessary modifications, repairs, or replacements to conform to the requirements of the Contract Documents and the pump shall be re-tested at no additional compensation, until found satisfactory.

3.03 PAINTING

A. Painting shall be in accordance with Section 11000, Equipment General Provisions. .

- END OF SECTION -

SECTION 11151 - VERTICAL NON-CLOG PUMPS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, test, paint, install and place into satisfactory service vertical non-clog pumps at the locations shown on the Drawings and as specified herein. All pumps shall be supplied by the same manufacturer.
- B. Equipment shall be provided in accordance with the requirements of Section 11000, Equipment General Provisions and Section 11100, Pumps - General.

1.02 COORDINATION

- A. To assure unity of responsibility, the motor and pump manufacturer provided as part of this Contract shall be furnished and coordinated by the pump manufacturer. The CONTRACTOR shall assume full responsibility for the coordination, factory testing, satisfactory installation and operation of the pumping systems, including pumps, motors, and electrical controls as specified.

1.03 SUBMITTALS

- A. Performance Affidavit: A performance affidavit shall be submitted with the Shop Drawings in accordance with, or in addition to the submittal requirements specified in Section 01300, Submittals; and Section 11000, Equipment General Provisions:
- B. Shop Drawings: Shop drawings shall be furnished as specified in Section 01300 and Section 11100. Pump Curves shall be submitted at minimum, intermediate and maximum operating speed.
- C. O&M Manuals: Prior to start-up the CONTRACTOR shall furnish complete operations and maintenance manuals in accordance with Section 01300, Submittals and Section 11000, Equipment General Provisions.
- D. Factory Test Reports and Field Test Reports: Factory test reports and Field Test Reports shall be submitted in accordance with Section 11100.
- E. Pipe Layout Drawings: Contractor shall submit pipe layout drawings and schedule with the pump shop drawings.
- F. Grout: Contractor shall submit manufacturer's information on type of grout to be used.
- G. Seal Water Panels: Contractor shall submit information on Seal Water Panels.

1.04 WARRANTY AND GUARANTEE

- A. Warranty and Guarantee shall be as specified in Section 11000 with the exception that the warranty period shall be for two (2) years.

PART 2 -- PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. All equipment shall be the product of acceptable manufacturers who have built equipment of similar size and capacity for at least ten years and who have, in the opinion of the ENGINEER, sufficient experimental and test data to confirm the design of the equipment specified.
- B. Acceptable manufacturers include Morris Model MF or equal.

2.02 GENERAL DESCRIPTION

- A. Identification

Pump Name	RAS Pump Station No. 1 Pumps
Equipment Number	RAS 64010, RAS 64011, RAS 64012
Quantity	3
Location	RAS Pump Station No. 1

- B. Operating Conditions

Duty	Continuous
Drive	Variable Frequency
Ambient environment	Indoors
Ambient temperature, degrees F	40 to 100
Ambient relative humidity, percent	0 to 100
Fluid service	Return Activated Sludge, 0 to 5% solids
Fluid temperature, degrees F	70 to 80
Minimum available NPSH, ft	Flooded Suction
Maximum size of spheres to pass, in. dia	4

C. Performance Requirements

Maximum Nominal Pump Speed (rpm)	1,200
Operating Point No. 1 – Design Point at Maximum Speed:	
Design flow capacity (gpm)	6,550
Design flow Total Dynamic Head (ft)	56
Minimum pump efficiency (%)	80
Design Flow Percent of BEP Flow (%)	85 to 100
Operating Point No. 2 at Maximum Speed:	
Flow capacity (gpm)	5,000
Minimum Total Dynamic Head (ft)	64
Minimum Pump Efficiency (%)	72
Minimum motor size, hp	125

D. NOMINAL PUMP SUCTION AND DISCHARGE NOZZLE SIZES:

Suction Flange (inches diameter)	16
Discharge Flange (inches diameter)	16

Pump Dimensions: The horizontal distance between the pump suction and discharge flange faces and the vertical offset between suction and discharge piping centerlines will vary depending on pump manufacturer furnished by CONTRACTOR. CONTRACTOR is responsible for adjusting piping and providing necessary reducers and specialty fittings to install the pumps furnished in the piping arrangement shown on the Drawings. CONTRACTOR shall submit pipe layout drawings and schedule with shop drawings for pump. It is noted that elevation of pump suction header and elevation of pump discharge piping at pump station wall is fixed.

2.03 MATERIALS

- A. Pump Design - The pump shall be bottom suction, side discharge construction and shall be supplied with an integral suction elbow of the pump manufacturer's design matched to the pump suction connection piece. The suction elbow shall be provided with an access hole and cover for access to the suction eye of the impeller. The volute shall be provided with a cleanout port to allow for removal of any foreign material blocking or impeding performance of the pump. The unit shall be designed such that the motor may be removed from the pump for independent servicing.
- B. Casing shall be made of close grained cast iron conforming to ASTM A48, Class 25 and 35 or ASTM 278, Class 30, and shall provide smooth unobstructed passages large enough to pass solids of the specified size. A cleanout handhole with removable cover shall be provided for non-clog type pumps. The inner contours of the handhole cover shall match the contours of the casing in which it fits. Casing shall be enclosed by a removable suction and stuffing box cover carefully machined and aligned. Suction and discharge connections shall be ANSI Standard flat faced 125 pound flanges, and shall be drilled and tapped for gauge, drain and vent connections or shall be self-venting. The necessary lifting bolts and eye lugs shall be provided for installation and maintenance of the pumps. Gauges shall be furnished and installed under Section 11100, Pumps - General. Taps ½ inch diameter for gauge connections shall be provided on all nozzles.
- C. Suction cover shall be constructed of the same material as the casing and shall be integrally cast with 125 pound ANSI standard flange. Cover shall be quickly removable for access to the impeller.
- D. Impeller shall be of the one piece, single suction, enclosed non-clog type and shall be made from closed-grain cast iron, conforming to ASTM A48, Class 30, and shall be statically, hydraulically, and dynamically balanced. The impeller shall be designed with smooth flow passages to pass solids of specified size and to prevent clogging by stringy materials. The impeller shall be bolted, keyed and locked to the pump shaft at the factory.
- E. Rotation of pumps shall be as shown on the Drawings.
- F. Stuffing box cover shall be constructed of cast iron, ASTM A48, Class 25 and 35, and shall be designed with a machined self-centering fit with the pump casing. Stuffing box shall be readily accessible. Tapped holes shall be provided for oil or seal water connection as specified. The stuffing box shall be provided with a tapped connection to install a drain line to divert seal flush leakage away from the top of the pump area.
- G. Stuffing box shall be supplied with a split type, cartridge mechanical seal. Stuffing box shall be provided with a nipple for connection to seal water system. Mechanical seals shall be Chesterton Model 442, no equal. Seal materials shall be silicon carbide rotating face, silicon carbide stationary face, EPDM elastomers and Type 316 stainless steel metal parts. Seals shall be factory installed. Seal shall be installed with a SpiralTrac, series D, box bushing. Seal water shall be non potable water.
- H. Each pump/mechanical seal shall be provided with a seal water panel as shown on the Drawings. Seal water panels shall be as recommended by Manufacturer. Panels shall utilize heavy gauge aluminum. Panels shall be as manufactured by Tom Evans Environmental, model TR-2 or equal. Location of seal water panels shall be coordinated

with Owner. Contractor shall provide stainless steel channels, stainless steel post base, and stainless steel expansion anchor anchors, nuts and washer for mounting seal water panels.

- I. Shaft shall be Type 416 stainless steel, minimum, sufficiently large in diameter to transmit safely the maximum torque developed by the drive unit and of such a design as to provide a rigid support for the impeller and to prevent excessive vibration. The shaft shall be suitably heat-treated, turned, ground, and polished over its entire length and shall be protected through the stuffing box by a removable hardened stainless steel shaft sleeve with seal to prevent leakage.
- J. Shaft sleeve shall be constructed of Type 316 stainless steel, and secured to prevent reversal of rotation. An "O" ring seal shall be provided between the shaft and the impeller hub to prevent leakage under the sleeve. The shaft sleeve shall not be threaded.
- K. Bearings shall be of the anti-friction ball or tapered roller type in a dust-proof housing. Bearings shall be oil or grease lubricated with provisions for the addition or draining of lubricant. The bearings shall be designed for continuous heavy duty loads and for both axial and radial thrust loads. The bearing frame shall be of rigid cast iron construction to support the shaft and the bearings, and shall be designed so that the complete rotating element can be removed from the casing without disconnecting the piping. Bearings shall have a minimum AFBMA B-10 life of 100,000 hours under worst possible operating conditions.
- L. Bearing housing shall be constructed of cast iron, ASTM, A48, Class 30 designed to provide a fully enclosed bearing housing.
- M. Impeller and case wearing rings shall be of the removable type, hardened 420 series stainless steel. One wearing ring shall be on the impeller and one on the casing. Wear rings shall be designed to compensate for a minimum of ¼-inch wear.
- N. Wear Adjustment - Rotating assembly shall be readily adjustable by jack screws at the end of the bearing housing so that, as wear occurs, proper impeller-to-suction cover liner clearance can be maintained without dismantling the pump.
- O. Base and Support Plate – The pump shall be supported by a cast iron mounting foot type pedestal cast integrally with the pump casing and sufficiently sized to ensure rigid support of the pump and motor. Pump support plate shall be a minimum of two (2) inches thick and shall be designed to anchor, with non-shrink, high strength grout, on the top of two parallel concrete piers. Pump support plate shall be manufactured of cast iron or steel and shall be provided with grout holes and drain connections with drip lip as necessary.
- P. Coupling - Pump shaft connections to drives shall be directly connected through flexible couplings as manufactured by Falk, Dodge, Steelflex or equal. Couplings shall be provided with coupling guards.

2.04 ELECTRICAL AND CONTROL REQUIREMENTS

- A. Electrical Requirements

Rating	460V, 3 phase, 60 Hz
Horsepower	125
Maximum Speed, rpm	1200
Enclosure	TEFC
Insulation	Class F
Inverter Duty	Yes
Drive	Variable Frequency
Service Factor	1.15
Space Heater	Yes
Motor Winding Temperature Switches	Yes
RTDs	Yes
Separate Cooling Fan	Yes – for motors less than 1200 rpm

2.05 FACTORY COATINGS

- A. Pump and motor assemblies (including baseplate) shall be coated at the factory with a primer. The prime coat shall be compatible with the finish coat specified in Section 09900.

2.06 SPARE PARTS

- A. Spare parts shall be provided in accordance with Section 11000, Equipment General Provisions.
- B. For EACH pump, provide the following spare parts:
 - 1. One (1) set of wearing rings
 - 2. One (1) - shaft sleeve
 - 3. One (1) - set of pump bearings
 - 4. One (1) - complete mechanical seal and one mechanical seal repair kit
 - 5. Two (2) - sets of gaskets and O-ring seals
 - 6. One year supply of all lubricating oils and greases
- C. In addition to the spare parts listed above, provide one (1) spare impeller, trimmed to meet specified performance requirements.

- D. In addition to the spare parts listed above, provide the following alignment and vibration equipment as manufactured by db PRUFTECHNIK:
- a. Rotalign Touch Full Package (Part # ALI 50.000 FULL)
 - b. VibXpert II 2-Channel Advanced with Balancing and Recording including the following:
 - i. VIB 5.314-2 – VibXpert II 2-Channel Advanced system with Omnitrend software
 - ii. VIB 5.316-BAL – VibXpert II Balancing firmware certificate
 - iii. VIB 5.315-REC – VibXpert II Recording firmware certificate
 - iv. VIB 5.386-HW – VibXpert II Sensor set for balancing with 2-Channel instrument

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 11000, Equipment General Provisions. For each series of pumps, field services shall include the following site visits:

Service	Number of Trips	Number of Days per Trip
Installation and Testing	2	1
Startup and Training	2	2

- END OF SECTION -

SECTION 11208 - SUMP PUMPS

PART 1 - GENERAL

1.01 THE REQUIREMENT

- A. Furnish all labor, equipment, and materials for construction of sump pumping systems as shown on the Drawings and specified herein.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 01300 – Submittals
- B. Section 01600 – Materials and Equipment
- C. Section 11000 – Equipment General Provisions
- D. Division 16 – Electrical

1.03 SUBMITTALS

- A. Submit shop drawings, pump curves and manufacturer's product literature as specified under Section 01300 - Submittals.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. ITT Goulds Pumps or equal.

2.02 SUMP PUMPS

- A. Type: Completely submersible vertical centrifugal sump pumps.
- B. Body: Cast iron.
- C. Shaft: Carbon steel.
- D. Integral Float Switch: The sump pump shall be furnished with an integral float switch to start and stop the sump pump.
- E. Power Cord: 10 feet. Provide appropriate plug for power receptacle as required.
- F. Electrical Data: The pump motor shall be designed for the following:
 - 1. Voltage: 115 volt
 - 2. Frequency: 60 Hertz.
 - 3. Phase: 1

4. Minimum Circuit Breaker Size: 15 amps
5. Maximum Motor Horsepower: 0.75
6. Maximum Motor Speed: 3,400 RPM
7. Motors shall be furnished with integral starter and thermal overload protection.

G. Pumps shall be capable of running dry without damage to components.

2.03 CONDITIONS OF SERVICE

Location	RAS Pump Station No. 1 Sump
Starting and Stopping Method	Integral Float Switch
Quantity Required	2
Nominal Discharge Size (inches FNPT)	1 1/2
Nominal Capacity (GPM)	30 gpm
Nominal Total Dynamic Head (feet)	25 feet
On Level (inches above sump floor)	12
Off Level (inches above sump floor)	As recommended by Manufacturer

PART 3 -- EXECUTION

3.01 INSTALLATION

- A. Installation shall be in accordance with the manufacturer's instructions.

- END OF SECTION -

DIVISION 12 – FURNISHINGS

NOT USED

DIVISION 13 – SPECIAL CONSTRUCTION

NOT USED

DIVISION 14 – CONVEYING SYSTEMS

NOT USED

DIVISION 15 – MECHANICAL CONSTRUCTION

SECTION 15000 - 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. All piping located outside the face of structures or building foundations and all piping embedded in concrete within a structure or foundation shall be considered exterior piping.
- 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.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Division 1, General Requirements
- B. Division 2, Sitework

- C. Division 5, Metals
- D. Division 9, Finishes
- E. Division 11, Equipment
- F. Division 16, Electrical

1.03 MANUFACTURERS

- A. The City of Hollywood requires all ductile iron pipe and fittings to be manufactured in America.

1.04 MATERIAL CERTIFICATION AND SHOP DRAWINGS

- A. The CONTRACTOR shall furnish to the CITY (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, 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 01300 – Submittals. In addition to the requirements of Section 01300 – Submittals, 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.

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 Section 3.09.
- C. Joints in piping shall be of the type as specified in the appropriate Piping System Schedule in Section 15390, Schedules.

- D. ALL BURIED EXTERIOR PIPING SHALL HAVE RESTRAINED JOINTS FOR THRUST PROTECTION UNLESS OTHERWISE SPECIFIED OR SHOWN ON THE DRAWINGS. ALL EXPOSED EXTERIOR PIPING SHALL HAVE FLANGED JOINTS, UNLESS OTHERWISE SPECIFIED OR SHOWN ON THE DRAWINGS.
- E. The CONTRACTOR shall verify existing above ground and buried piping tie-in connections before fabricating new piping assemblies. The CONTRACTOR shall verify size, type, and location of all existing buried piping and appurtenances by excavating test pits as required of all buried 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.
- F. Before setting wall sleeves, pipes, castings and pipes to be cast in place, the CONTRACTOR shall check the Drawings and equipment manufacturer's drawings which may have a direct bearing on the pipe locations.
- G. Piping shall be attached to pumps, valves, equipment, etc., in accordance with the respective manufacturers' recommendations. This includes the use of flexible connectors as required.
- H. All changes in directions or elevations shall be made with fittings, unless otherwise shown.

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:

<u>Pipe Size</u>	<u>Waterstop Flange Diameter</u>	<u>Waterstop Flange Thickness</u>
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"
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 09900 – 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 the Thunderline Corp., Wayne, Michigan, 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 304 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 low carbon steel, zinc galvanized 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 effect 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

- 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.

2.05 FLEXIBLE COUPLINGS

- A. Flexible couplings shall be as manufactured by the Red Valve Company and shall consist of a molded reinforced fabric of cotton and natural rubber. Galvanized steel retaining rings shall be furnished. End connections shall match ANSI 125 pound flanges with a minimum pressure rating of 140 psi.

2.06 SLEEVE TYPE COUPLINGS

- A. Sleeve type, flexible couplings shall be furnished and installed where shown on the Drawings or otherwise required to resist internal operating pressures. In addition to that specified herein, harnessed, sleeve type flexible couplings shall be provided on all exposed pipe 3 inches and larger in diameter that spans any expansion joint in a building or structure.

- B. Materials shall be of high strength steel and couplings shall be rated for the same pressures as the connecting piping.
- C. Gaskets shall be rubber. Bolts and nuts shall be alloy steel, corrosion-resistant and prime coated.
- D. Couplings shall be shop primed with a premium quality primer compatible with the painting system specified in Section 09900 - Painting. Field painting of wetted area shall be done prior to installation.
- E. Harnessing
 - 1. Harness couplings to adjacent flanges as shown, specified or otherwise required to restrain all pressure piping.
 - 2. Dimensions, sizes, spacing and materials for lugs, tie rods, washers, and nuts shall conform to the standards for the pipe size, and design pressure specified.
 - 3. No less than two (2) bolts shall be furnished for each coupling.
 - 4. Tie bolts, nuts and washers shall be ASTM A 193, Grade B7 steel or better and as a minimum shall be hot dip galvanized.
 - 5. Harness rods shall have lengths less than 10 feet between adjacent flanged joints on fittings and as a minimum shall be hot dip galvanized.
- F. Couplings shall be as manufactured by Dresser Industries, Style 38, or equal as required and shown on the Drawings. All couplings shall be provided without interior pipe stop.

2.07 FLANGED ADAPTERS

- A. Flanged adapters shall be furnished as required and as shown on the Drawings.
- B. All flanged adapters, 12 inches in diameter and smaller, except as shown on the Drawings or directed by the ENGINEER, shall be locking type flanged adapters.
- C. Pressure and service shall be the same as connected piping.
- D. Materials shall be cast iron for pipes up to 12 inch diameter and high strength steel for pipes larger than 12 inch diameter.
- E. Flanged adapters shall be shop primed with a premium quality primer compatible with the paint system specified in Section 09900 – Painting. Field painting of wetted area shall be done prior to installation.
- F. Bolts and nuts shall be alloy steel, corrosion-resistant and prime coated.
- G. Where identified on the Drawings, flanged coupling adapters shall be harnessed by tying the adapter to the nearest pipe joint flange using threaded rods and rod tabs. The threaded

rods, rod tabs, nuts, bolts and washers shall be as shown on the Drawings and as a minimum shall be hot dip galvanized.

- H. Flanged adapters shall be as manufactured by Dresser Industries, Style 127 or 128, Smith Blair Corporation, or equal.

2.08 MECHANICAL COUPLINGS (SPLIT TYPE - SHOULDERED END)

- A. Mechanical couplings (split type-shouldered end) 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 09900 - Painting.
- E. Couplings shall be as manufactured by Victaulic Company of America, Style 44, or equal.

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 polyallomor 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 (polyallomor) 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 RESTRAINED JOINTS

- A. Where required for ductile iron pipe, unless specified elsewhere, all mechanical joint fittings, valves and appurtenances shall be restrained as described herein. The restraint rings shall be manufactured of ductile iron conforming to ASTM A536 and incorporate a plurality of individually-actuating gripping surfaces to grip the pipe. The restraint device shall be coated in MEGA-BOND Restraint Coating System. The restraint system shall consist of two series 1100 MEGALUGS mechanical joint restraint follower glands with the second follower gland having the mechanical joint lip removed at the factory to seat properly behind the first. The restraint system shall have a sufficient number of fastening bolts to connect the rings to the mechanical joint. Torque limiting twist off nuts shall be used to ensure proper actuation of the restraining wedges. The restraint system shall have a minimum safety factor of 2 to 1. The restraint system shall be the Series 1100TDM Tandem MEGALUG Mechanical Joint Restraint manufactured by EBAA Iron, Inc., no exceptions.
- B. Where required for PVC pipe, unless specified elsewhere, restrained joint retainer glands shall be used and shall be cast from 60-42-10 ductile iron and shall have a sufficient number of ductile tie bolts to restrain working test pressure as required. The retainer clamp shall be of two piece construction with serrations on the I.D. sufficient to hold the required pressures with a safety factor of 2:1. The retainers shall be Series 1500 or 6500 as manufactured by EBAA Iron, Inc., no exceptions.

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, it 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 MANUFACTURERS RECOMMENDED DEFLECTION. Excavation and backfilling shall conform to the requirements of Division 2, 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 relaid 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.
- 3.02 REINFORCED CONCRETE PIPE, CONCRETE CULVERT, AND DRAIN PIPE
- A. The laying of reinforced concrete pipe shall conform to the applicable sections of the Concrete Pipe Handbook as published by the American Concrete Pipe Association.

3.03 DUCTILE IRON PIPE

- A. Ductile iron pipe (DIP) shall be installed in accordance with the requirements of the Ductile Iron Pipe Handbook published by the Ductile Iron Pipe Research Association, and AWWA C600.
- B. Where it is necessary to cut ductile iron pipe in the field, such cuts shall be made carefully in a neat workmanlike manner using approved methods to produce a clean square cut. The outside of the cut end shall be conditioned for use by filing or grinding a small taper, at an angle of approximately 30 degrees.
- C. UNLESS OTHERWISE APPROVED BY THE ENGINEER, FIELD WELDING OF DUCTILE IRON WILL NOT BE PERMITTED.

3.04 PVC/CPVC AND HDPE PIPE

- 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.

3.05 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.

3.06 COPPER PIPE

- A. Installation of copper pipe shall be by skilled workman in accordance with the manufacturer's recommendations. Use teflon tape at all fittings unless otherwise required for intended service. Install unions at the connections to each piece of equipment to allow removal of equipment without dismantling connecting piping.
- B. Wall sleeves shall be provided for all piping passing through exterior walls and shall be of the same material as the piping to which it is joined. All wall sleeves shall be provided with an acceptable waterstop.
- C. The CONTRACTOR shall provide hot and cold water mains with branches and risers complete from point indicated on the Drawings running to all fixtures and other outlets indicated. Mains and branches shall be run generally as shown on the Drawings. The CONTRACTOR shall provide all interior water piping, branches, and risers as shown on the Drawing and shall make connections to all plumbing fixtures, hose bibs, wall hydrants, and other points requiring water under this and other Divisions of the Specifications.
- D. All water mains and branches shall be pitched at least one (1) inch in twenty-five (25) feet toward fixtures. The piping installation shall be arranged so that the entire system can be drained through fixture supply connections.
- E. Unions shall be installed at the connections to each piece of equipment to allow for removal of equipment without dismantling connecting piping.
- F. Joints 1-1/4 inches and larger shall be made with silver solder. For joints less than 1-1/4 inches and all valves (regardless of size) use 95/5 solder. Soldered joints shall be prepared with a non-corrosive paste flux in accordance with manufacturer's instructions. All joints shall be thoroughly cleaned with emery cloth and reamed out before assembly. Acid core solder will not be permitted.

3.07 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 unions shall be installed wherever dissimilar metals are connected except for bronze or brass valves in ferrous piping. Unions shall be provided downstream of each valve with screwed connections. The CONTRACTOR shall provide screwed or flanged unions at each piece of equipment, where shown, and where necessary to install or dismantle piping.
- 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 shall be butt fusion weld. All butt welding shall follow the requirements of ASTM D-2657 and the manufacturer's recommendations.

3.08 PAINTING AND COLOR CODING SYSTEM

- A. All exposed piping specified shall be color coded in accordance with the CITY's standard color designation system for pipe recognition and in accordance with Section 15030 – 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 09900 – Painting.
- B. All piping specified in this Section shall be painted in accordance with Section 09900 – Painting, except as follows:
 - 1. Copper pipe
 - 2. Stainless steel pipe. Flanges and supports or hangers shall be painted.

- END OF SECTION -

SECTION 15006 - DUCTILE IRON PIPE

PART 1 -- GENERAL

1.01 WORK INCLUDED

- A. The Contractor shall furnish and install ductile iron pipe and all appurtenant Work, complete in place, all in accordance with the requirements of the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Materials and Equipment
- B. Excavation and Backfill for Utilities
- C. Submittals
- D. Painting
- E. Basic Mechanical Requirements
- F. Schedules
- G. Pipeline Testing

1.03 REFERENCED SPECIFICATIONS, CODES, AND STANDARDS

- A. Commercial Standards:

ANSI/AWWA C104/A21.4	Cement Mortar Lining for Ductile Iron Pipe and Fittings for Water
ANSI/AWWA C110/A21.10	Ductile-iron and Gray-Iron Fittings 3-in. Through 60-in. for Water and Other Liquids
ANSI/AWWA C111/A21.11	Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings
ANSI/AWWA C150/A21.50	Thickness design of ductile iron pipe
ANSI/AWWA C151/A21.51	Ductile-iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids
ANSI/AWWA C600	Installation of Ductile-Iron Water Mains and Appurtenances

1.04 SUBMITTALS

- A. Shop Drawings: The Contractor shall submit Shop Drawings of pipe and fittings in accordance with the requirements set forth in the Sections entitled "Basic Mechanical Requirements" and "Submittals".

- B. Contractor shall submit certification that all materials coming in contact with potable water comply with the requirements of NSF 61.

1.05 SCHEDULE OF PIPING MATERIALS

- A. A schedule of piping materials is included in the Section entitled "Schedules". The schedule indicates service, nominal pipe size, material, wall thickness, joint type, working pressure, test pressure, joints, coatings and linings.

PART 2 -- PRODUCTS

2.01 GENERAL

- A. The City of Hollywood requires all ductile iron pipe and fittings to be manufactured in America.
- B. Pipe shall be centrifugally cast in metal molds or sand lined molds in accordance with ANSI A21.51 (AWWA C151) of grade 60-42-10 ductile iron. The above standard covers ductile iron pipe with nominal pipe sizes from three inches up to and including sixty-four inches in diameter. Working pressure shall be as specified herein, unless higher pressure is indicated on the Piping Schedule in Section 15390 – Schedules.

- B. Wall Thickness

1. Buried Pipe: Pressure Class 350
2. Flanged Pipe: Pipe wall thickness of threaded pipe for a flanged pipe end shall be minimum special thickness Class 53 from 4-inch to 54-inch and/or minimum pressure Class 350 for 60-inch to 64-inch diameter pipe in accordance with AWWA C115.
3. Grooved Pipe: Grooved coupling pipe shall be Special Thickness Class 54.

- C. Joints

1. Ductile iron pipe above grade shall be flanged.
2. All pipe and fittings below grade shall be restrained joint type.
3. Mechanical and push-on type joints shall be in accordance with ANSI A21.11 (AWWA C111).
4. Flanges for flanged pipe shall be in accordance with ANSI A21.15 (AWWA C115), shall be ductile iron, shall be rated at 250 psi maximum working pressure, and shall be similar to flange Class 125 per ANSI B16.1. Where shown on the Drawings, pipe and fittings shall be furnished with flanges similar to flange Class 250 per ANSI B16.1. Fittings shall be provided with flanges having a bolt circle and bolt pattern the same as the adjacent pipe and/or mechanical devices.
5. Bolts: hot dip galvanized carbon steel bolts and nuts.

6. No raised face flanges shall be used. The raised faces shall be milled flat.
7. Gasket Material: Gaskets shall be full faced neoprene rubber for wastewater service.

D. Restrained Joints

1. All ductile iron pipe and fittings below grade shall be restrained joint.
2. Manufactured Proprietary Restrained Joint Piping and Fittings: Restrained joint pipe and fittings shall be Flex-Ring or Lok-Ring type as manufactured by American Cast Iron Pipe, TR Flex as manufactured by U.S. Pipe, or equal.
3. Restrained Mechanical Joint Fittings: All mechanical joint fittings, valves and appurtenances shall be restrained as described herein. The restraint rings shall be manufactured of ductile iron conforming to ASTM A536 and incorporate a plurality of individually-actuating gripping surfaces to grip the pipe. The restraint device shall be coated in MEGA-BOND Restraint Coating System. The restraint system shall consist of two series 1100 MEGALUGS mechanical joint restraint follower glands with the second follower gland having the mechanical joint lip removed at the factory to seat properly behind the first. The restraint system shall have a sufficient number of fastening bolts to connect the rings to the mechanical joint. Torque limiting twist off nuts shall be used to ensure proper actuation of the restraining wedges. The restraint system shall have a minimum safety factor of 2 to 1. The restraint system shall be the Series 1100TDM Tandem MEGALUG Mechanical Joint Restraint manufactured by EBAA Iron, Inc., no exceptions.
4. Restraining System for Field Cut Piping: Use only in areas where adjoining to fixed points where laying length is determined in field and requires field cutting of the pipe. Ductile iron pipe bell restraint shall consist of a wedge action restraint ring on the spigot joined to a split ductile iron ring behind the bell. The restraint ring shall have individually actuated wedges that increase their resistance to pull-out as pressure or external forces increase. Torque limiting twist off nuts shall be used to ensure proper actuation of the restraining wedges. The restraint devices shall be coated using MEGA-BOND. The product shall be the Series 1700 Megalug restraint harness, manufactured by EBAA Iron, Inc., no exceptions.

E. Fittings

1. General: Fittings shall be manufactured in accordance with AWWA C110 or AWWA C153 or the manufacturer's standard.
2. Materials: Fittings shall be ductile iron.
3. Joints - General: Fittings shall be either flanged, mechanical joint or manufactured proprietary restrained joint type as indicated on the Drawings and specified herein.
4. Flanged Joint Fittings: Above ground fittings shall be flanged.
5. Manufacturer Proprietary Restrained Joint Fittings: All below ground fittings 30-inches in diameter and greater shall be manufacturer proprietary restrained joint

type.

6. Mechanical Joint Fittings: Underground ductile iron fittings 24-inches in diameter and less shall be mechanical joint type fittings.

F. Joint Pressure Ratings:

1. Flanged Joints: The flanges shall be rated for at least 250 psi working pressure.
2. Grooved Joints:
 - a) Fittings 4 to 36-inch Diameter with Grooved Joints: Maximum 250 psi working pressure.
 - b) Grooved Couplings 4 to 18-inch Diameter: Maximum 250 psi working pressure
 - c) Grooved Couplings 20 to 36-inch Diameter: Maximum 150 psi working pressure.
3. Restrained, Push-on and Mechanical Joints:
 - a) 4 to 24-inch Diameter: Maximum 350 psi working pressure.
 - b) 30 to 64-inch Diameter: Maximum 250 psi working pressure.

F. Pipe Lining and Coating General: Pipe linings and coatings shall be as follows.

1. Buried Service: The piping manufacturer's standard asphaltic coating shall be applied prior to shipment to the exterior wall of buried pipe and fittings in accordance with AWWA C151.
2. Above Ground Piping and Exposed Piping within Underground Vaults: A coating of rust inhibitive primer, compatible with the coating system specified in Section 09900 – Painting, shall be applied to the pipe exterior prior to shipment for piping that is above ground and exposed piping within vaults. Primer for pipe used for potable water main applications shall be compliant with NSF Standard 61.
3. Cement-Mortar Lining: Where scheduled, pipe and fittings shall be cement-lined and seal-coated in accordance with AWWA C104, Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
4. Protecto 401 Ceramic Epoxy Lining: The interior of all ductile iron pipe and fittings for non-potable service shall be lined with an epoxy lining, unless otherwise specified. The epoxy lining shall be Protecto 401 Ceramic Epoxy as manufactured by the Protecto Division of Vulcan Painters, Inc, or equal. All pipe and fittings shall be lined with a minimum dry film thickness of 40 mils, except for the gasket groove and spigot end up to six inches back from the end of the spigot which shall be lined with ten mils of the material. All ductile iron pipe and fittings shall be checked for dry film thickness in accordance with the SSPC-PA2. Each pipe joint and fitting shall be marked with the date of application of the lining system and with its numerical sequence of application on that date. The pipe supplier shall furnish a certificate stating that lining applicator has complied with all specification requirements relative

to the material, its application and inspection. Surface preparation, number of coats, application of the lining material and field touch-up shall be in strict accordance with the lining material manufacturer's recommendations. During the installation of the pipe, the lining material manufacturer shall provide the services of a field engineer to instruct and demonstrate to the CONTRACTOR's personnel, the procedure for the field touch-up of lining where field cuts and taps were required. Holiday inspection shall be conducted using test equipment described in American Water Works Association Standard, AWWA C210, Section 5.3.3.1. In accordance with coating manufacturer's recommendation, holiday testing may be conducted any time after the coating has reached sufficient cure.

5. Polyethylene Encasement: All ductile iron pipe, fittings and valves installed underground shall be encased with polyethylene film in accordance with ANSI Standard A21.5, Method A or B at the CONTRACTOR's option. Encasement shall terminate 3-inches to 6-inches above ground where pipe is exposed

F. Color Coding for Potable Water Mains:

1. Above Ground Piping: Pipe used for potable water main applications in above ground service shall be painted blue.
2. Below Ground Piping: Pipe used for potable water main applications in below ground service shall have a continuous blue line painted along the top of the pipe.

PART 3 -- EXECUTION

3.01 INSTALLATION

- A. The Contractor shall perform all earthwork including excavation, backfill, bedding, compaction, sheeting, shoring and bracing, dewatering and grading in accordance with Division 2 - Sitework.
- B. Unless otherwise directed, ductile iron pipe shall be laid with the bell ends facing upstream in the normal direction of flow and in the direction of laying.
- C. Thrust restrained and mechanical joints shall be made in accordance with the manufacturer's standards except as otherwise specified herein. Joints between mechanical joint pipe and/or fittings shall be made in accordance with ANSI/AWWA Standard C600, except that deflection at joints shall not exceed one-half of the manufacturer's recommended allowable deflection, or one-half of the allowable deflection specified in ANSI/AWWA C600, whichever is the lesser amount.
- D. Before laying thrust restrained and mechanical joint pipe and fittings, all lumps, blisters and excess bituminous coating shall be removed from the bell and spigot ends. The outside of each spigot and the inside of each bell shall be wire brushed, and wiped clean and dry. The entire gasket groove area shall be free of bumps or any foreign matter which might displace the gasket. The cleaned spigot and gasket shall not be allowed to touch the trench walls or trench bottom at any time. Vegetable soap lubricant shall be applied in accordance with the pipe manufacturer's recommendations, to aid in making the joint. The workmen shall

exercise caution to prevent damage to the gasket or the adherence of grease or particles of sand or dirt. Deflections shall only be made after the joint has been assembled.

- E. Prior to making up flanged joints in ductile iron pipe and fittings, the back of each flange under the bolt heads and the face of each flange shall have all lumps, blisters and excess bituminous coating removed and shall be wire brushed and wiped clean and dry. Flange faces shall be kept clean and dry when making up the joint, and the workmen shall exercise caution to prevent damage to the gasket or the adherence of grease or particles of sand or dirt. Bolts and nuts shall be tightened by opposites in order to keep flange faces square with each other, and to insure that bolt stresses are evenly distributed.
- F. Bolts and nuts in thrust restrained, mechanical and flanged joints shall be tightened in accordance with the recommendations of the pipe manufacturer for a leak-free joint. The mechanics shall exercise caution to prevent overstress. Torque wrenches shall be used until, in the opinion of the ENGINEER, the mechanics have become accustomed to the proper amount of pressure to apply on standard wrenches.
- G. Cutting of the ductile iron pipe for inserting valves, fittings, etc., shall be done by the Contractor in a neat and workmanlike manner without damage to the pipe, the lining, or the coating. Pipe 16 inches and larger in diameter shall be cut with a mechanical pipe saw. After cutting the pipe, the plain end shall be beveled with a heavy file or grinder to remove all sharp edges.
- H. Areas of loose or damaged lining associated with field cutting shall be repaired or replaced as recommended by the pipe manufacturer and required by the ENGINEER. Repair methods shall be as recommended by the manufacturer and shall be submitted to the ENGINEER for review.
- I. Any work within the pipe shall be performed with care to prevent damage to the lining. No cable, lifting arms or other devices shall be inserted into the pipe. All lifting, pulling or pushing mechanisms shall be applied to the exterior of the pipe barrel.
- J. Homing the pipe shall be accomplished by the use of a hydraulic or mechanical pulling device, unless otherwise accepted by the ENGINEER. No pipe shall be driven or struck in order to seat it home.
- K. Cleaning: Cleaning methods shall be acceptable to the ENGINEER, and must be sufficient to remove silt, rocks, or other debris which may have entered the pipeline during its installation and shall also follow the requirements of Section 15995, "Pipeline Testing and Disinfection".

- END OF SECTION -

SECTION 15009 – PVC PRESSURE PIPE

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. This section includes materials, installation, and testing of polyvinyl chloride (PVC) pipe and fittings for use in process piping having a maximum operating pressure of 150 psi at a maximum operating temperature of 100 degrees F and a maximum operating pressure of 100 psi at a temperature of 120 degrees F.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 01300 – Submittals
- B. Section 01600 – Materials and Equipment
- C. Section 15000 – Basic Mechanical Requirements

1.03 SUBMITTALS

- A. Submit shop drawings in accordance with the General Conditions.
- B. Submit materials list.
- C. Submit manufacturer's recommended method of installing buried pipe. Show alignments and offsets for "snaking" buried pipe.

PART 2 -- MATERIALS

2.01 PIPE

- A. Pipe shall be Schedule 80, Type 1, Grade 1 (Class 12454B), conforming to ASTM D 1784, except as noted below.

2.02 NIPPLES

- A. Short nipples shall be the same as the PVC pipe.

2.03 FITTINGS

- A. Fittings shall be Schedule 80 and shall conform to ASTM D 2464 for threaded fittings and ASTM D 2467 for socket-type fittings.

2.04 FLANGES

- A. PVC flanges shall be made of the same material as the pipe. Flanges shall match the dimensions of ANSI B16.5, Class 150, steel flanges. Flanges shall be flat face.
- B. Flanges shall be Van Stone style unless otherwise noted.

2.05 UNIONS

- A. Union shall have socket-type ends, EPDM o-rings, and shall be Schedule 80. Material shall be Type 1, Grade 1 PVC, per ASTM D 1784, Class 12454B.

2.06 JOINTS

- A. Pipe and fittings joints shall be socket welded except where threaded and flanged joints are required to connect to unions, valves, and equipment.
- B. Solvent cement for socket joints shall comply with ASTM D 2564 and be NSF listed for potable water.
- C. Manufacturer shall provide written conformance of solvent cement with intended chemical application.

2.07 BOLTING AND NUTS FOR FLANGES

- A. Bolts and nuts for interior flanges shall be carbon steel conforming to ASTM A 307, Grade B.
- B. Bolts and nuts for buried flanges and flanges located outdoors above ground or in vaults and structures shall be Type 316 stainless steel conforming to ASTM A 193, Grade B8M for bolts, and ASTM A 194, Grade 8M for nuts. Bolts and nuts larger than 1-1/8 inch shall be steel, ASTM A 307, Grade B, with cadmium plating, ASTM A 165, Type NS.
- C. Provide washers for each nut. Washers shall be of the same material as the nut.

PART 3 -- EXECUTION

3.01 GENERAL

- A. Do not install PVC pipe when the temperature is below 40 F or above 90 F. Store loose pipes on racks with a minimum support spacing of 3 feet. Provide shade for pipe stored outdoors or installed outdoors until the pipe is filled with water.
- B. Store fittings indoors in their original cartons.
- C. Store solvent cement indoors or, if outdoors, shade from direct sunlight exposure. Do not use solvent cements which have exceeded the shelf life marked on the storage container.
- D. Before installation, check pipe and fittings for cuts, scratches, gouges, buckling, kinking, or splitting on pipe ends. Remove any pipe section containing defects by cutting out the damaged section as a complete cylinder.

3.02 INSTALLATION

- A. Do not drag PVC pipe over the ground, drop it onto the ground, or drop objects on it. Cut pipe ends square and remove all burrs, chips, and fillings before joining pipe or fittings. Bevel solvent welded pipe ends as recommended by the pipe manufacturer.

3.03 SOLVENT WELDED JOINTS

- A. Prior to solvent welding, remove fittings and couplings from their cartons and expose them to the air for at least one hour to the same temperature conditions as the pipe.
- B. Wipe away loose dirt and moisture from the ID and OD of the pipe end and the ID of the fitting before applying solvent cement. Do not apply solvent cement to wet surfaces.
- C. Make up solvent welded joints per ASTM D 2855.
- D. Allow at least eight hours of drying time before moving solvent welded joints or subjecting the joints to any internal or external loads or pressures.

3.04 FLANGED JOINTS

- A. Lubricate bolt threads with MRO solution 1000 Food Grade Antiseize, or equal before installation.
- B. Tighten bolts on PVC flanges by tightening the nuts diametrically opposite each other using a torque wrench. Complete tightening shall be accomplished in stages and the final torque values shall be as shown in the following table:

<u>Pipe Size (inches)</u>	<u>Final Torque (foot-pounds)</u>
1/2 to 1-1/2	10 to 15
2 to 4	20 to 30
5 to 8	30 to 40
10	60 to 70

3.05 THREADED JOINTS

- A. Cut threaded ends on PVC to the dimensions of ANSI B2.1. Ends shall be square cut. Follow the pipe manufacturer's recommendations regarding pipe holddown methods, saw cutting blade size, and saw cutting speed.
- B. Pipe or tubing cutters shall be specifically designed for use on PVC pipe. Use cutters manufactured by Reed Manufacturing Company, Ridge Tool Company, or equal.
- C. If a holddown vise is used when the pipe is cut, insert a rubber sheet between the vise jaws and the pipe to protect from scratching the pipe.
- D. Thread cutting dies shall be clean and sharp and shall not be used to cut materials other than plastic.
- E. Apply Teflon thread compound or Teflon tape lubricant to threads before screwing on the fitting. Teflon tape shall be of type A-A-58092 or MIL-T-27730A manufactured by

Threadmaster or equal. Use White tape for all chemical applications and Pink tape for all water applications.

3.06 INSTALLING UNIONS

- A. Provide unions on exposed piping 3 inches and smaller as follows:
 - 1. Provide a union at every change in direction (horizontal and vertical).
 - 2. Provide a union 6 to 12 inches downstream of valves.
 - 3. Provide a union every 40 feet in straight piping runs.
 - 4. Near threaded connections to mechanical or piping equipment.
 - 5. Where shown on the Drawings.

3.07 INSTALLING BURIED PIPE

- A. Trench bottom shall be continuous, smooth, and free of rocks. See the details on the Drawings for trench dimensions, pipe bedding, and backfill.
- B. After the pipe has been solvent welded and the joints have set, snake the pipe in the trench per the pipe manufacturer's recommendations in order to allow for thermal expansion and contraction of the pipe.
- C. Do not backfill the pipe trench until the solvent welded joints have set. Support the pipe uniformly and continuously over its entire length on firm, stable soil. Do not use blocking to change pipe grade or to support pipe in the trench.
- D. Install buried PVC pipe in accordance with ASTM D 2774 and the pipe manufacturer's recommendations. Backfill materials in the zone between the trench bottom and to a point 8 inches above the top of the pipe shall be imported fill per Section entitled "Excavation and Backfill for Utilities". Compact by means of vibratory equipment or by flooding. Apply backfill in layers having a maximum thickness of 8 inches. If water flooding is used, do not add successive layers unless the previous layer is compacted to 90% relative compaction.

3.08 INSTALLING ABOVEGROUND PIPE

- A. Install pipe on pipe hangers and supports as detailed on the Drawings and as specified in Section entitled "Pipe Supports". Install pipe without springing, forcing, or stressing the pipe or the adjacent valves and equipment to which the pipe is connected.

3.09 PAINTING AND COATING

- A. Coat piping in accordance with requirements of section entitled, "Painting".

3.10 HYDROSTATIC TESTING

- A. Perform hydrostatic testing for leakage in accordance with requirements set forth in Section entitled "Pipeline Testing".

- END OF SECTION -

SECTION 15020 - PIPE SUPPORTS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. Reference Section 05050, Metal Fastening.
- B. Reference Section 15000, Basic Mechanical Requirements.

PART 2 -- PRODUCTS

2.01 HANGERS AND SUPPORTS

- A. All piping shall be adequately supported and braced by means of adequate hangers, concrete piers, pipe supports, brackets, or otherwise as may be required by the location. 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, 4 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.
- B. Hangers and supports shall conform to the following requirements:
 - 1. All hangers and supports shall be capable of adjustment after installation. Types of hangers and supports 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 supported at each floor and between floors by stays or braces to prevent rattling and vibration.
 - 4. Supports and hangers for plastic 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. Copper piping shall be supported by plastic coated or copper plated hangers and supports.
 - 7. Plastic piping shall be supported by plastic coated hangers and supports.
 - 8. Hangers and supports shall provide for thermal expansion throughout the full operating temperature range.

9. Expansion type anchors used for pipe hangers and supports shall be Type 304 stainless steel.
- C. All metallic hangers and supports shall 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. Materials of construction shall be as identified in Table 15020-1.
- D. Non-metallic support system 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.

Table 15020-1
Metal Hanger and Support Materials of Construction

Facility, Structure or Area ⁽²⁾	Required Material ⁽¹⁾	
	316 Stainless Steel	Hot Dip Galvanized Steel
General Site/Yard Piping ⁽³⁾		X
RAS Pump Station	X	
All Other Areas		X

(1) Refer to Specification Section 05010 – Metal Materials for grade requirements of steel for pipe supports.

(2) The limits of each facility/structure identified above shall extend to 5 feet beyond the perimeter walls or pads of each facility/structure.

(3) General Site/Yard Piping shall account for all areas of the project site up to the limits of facilities/structures identified above.

PART 3 -- EXECUTION

(NOT USED)

- END OF SECTION -

SECTION 15030 - 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 09900 - 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 01300 - Submittals, 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 15000 - 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 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. Piping and Equipment shall be color coded to match existing. Contractor shall field verify colors and obtain approval from City during shop drawing review.

PART 3 -- EXECUTION

(NOT USED)

- END OF SECTION -

SECTION 15095 – 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. The provisions of this Section shall apply to all valves and valve operators specified in the various Sections of these Specifications except where otherwise specified in the Contract Documents. Valves and operators in particular locations may require a combination of units, sensors, limit switches, and controls specified in other sections of these Specifications.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 09900 – Painting
- B. Section 11000 – Equipment General Provisions
- C. Section 15000 – Basic Mechanical Requirements

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Codes: All codes, as referenced herein, are specified in Section 01600, Reference Standards.

- B. Commercial Standards:

ASME B16.1	Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800.
ANSI B16.5	Pipe Flanges and Flanged Fittings, Steel Nickel Alloy and Other Special Alloys.
ANSI/ASME B1.20.1	General Purpose Pipe Threads (Inch).
ANSI/ASME B31.1	Power Piping.
ASTM A 36	Specification for Structural Steel.
ASTM A 48	Specification for Gray Iron Castings.
ASTM A 126	Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
ASTM A 536	Specification for Ductile Iron Castings.

ASTM B 61	Specification for Steam or Valve Bronze Castings.
ASTM B 62	Specification for Composition Bronze or Ounce Metal Castings.
ASTM B 148	Specification for Aluminum-Bronze Castings.
ASTM B 584	Specification for Copper Alloy Sand Castings for General Applications.
ANSI/AWWA C500	Metal-Seated Gate Valves for Water Supply Service.
ANSI/AWWA C504	Rubber-Seated Butterfly Valves.
AWWA C508	Swing-Check Valves for Waterworks Service, 2 Inches Through 24 Inches NPS.
ANSI/AWWA C509	Resilient-Seated Gate Valves for Water Service.
AWWA C550	Protective Interior Coatings for Valves and Hydrants.

1.04 CONTRACTOR SUBMITTALS

- A. Shop Drawings: Shop Drawings conforming to the requirements of Section 01300, Submittals, 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.
- B. Operation and Maintenance Manuals: 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.
- C. Valve Labeling: The CONTRACTOR shall submit a schedule of valves to be labeled indicating in each case the valve location and the proposed wording for the label.

1.05 QUALITY ASSURANCE

- A. Valve Testing: Unless otherwise specified, each valve body shall be tested under a test pressure equal to twice its design water-working pressure.

- B. Bronze Parts: Unless otherwise specified, all interior bronze parts of valves shall conform to the requirements of ASTM B 62, or, where not subject to dezincification, to ASTM B 584.

PART 2 -- PRODUCTS

2.01 VALVES

- A. General: The CONTRACTOR shall furnish all valves, valve- operating units, stem extensions, and other accessories as shown or specified. All valves shall be new and of current manufacture. All shut-off valves, 6-inch and larger, shall have operators with position indicators. Where buried, these valves shall be provided with valve boxes and covers containing position indicators, and valve extensions. Shut-off valves mounted higher than 6-feet above working level shall be provided with chain operators. All valves shall have a minimum design pressure rating of 150 psi and capable of a test pressure of 300 psi. For service applications with pressures in excess of 150 psi, valves shall have a minimum pressure rating in excess of the service application working pressure.
- B. Materials: 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. Cast iron parts of valves shall meet the requirements of ASTM A 126, "Standard Specifications for Grey Iron Castings for Valves, Flanges and Pipe Fittings, Class 'B'." All castings shall be clean and sound, without defects of any kind and no plugging, welding or repairing of defects will be permitted. Nonferrous alloys of various types shall be used for parts of valves as specified. Where no definite specification is given, the material shall be the recognized acceptable standard for that particular application.
- C. End Connections: Valves shall have flanged ends for exposed service and mechanical joint ends for buried service, unless otherwise shown on the Drawings or specified herein.
- D. All buried valves shall be provided with cast-iron valve boxes unless otherwise indicated. The boxes shall be asphalt varnished, or enameled cast iron, adjustable to grade, and installed perpendicularly, centered around and covering the upper portions of the valve or valve operator, or the pipe. The top of each valve box shall be placed flush with finish grade unless otherwise indicated on the Drawings. Valve boxes shall be as specified elsewhere in this section.
- E. All buried valves and other valves located below the concrete operating deck or level, specified or noted to be key operated, shall have an operator to finish grade or deck level, a 2-inch square AWWA operating nut, and cover or box and cover, as may be required.
- F. Valve Flanges: Flanged ends shall be flat-faced and have bolt circle and bolt patterns conforming to ANSI B16.1 Class 125 unless otherwise specified hereinafter. All bolt heads and nuts shall be hexagonal conforming to ANSI B18.2. Gaskets shall be full face and made of natural or synthetic elastomers in conformance with ANSI B16.21 suitable for the service characteristics, especially chemical compatibility and temperature.
- G. Gate Valve Stems: Where subject to dezincification, gate valve stems shall be of bronze to ASTM B 62, containing not more than 5 percent of zinc or more than 2 percent of aluminum. Where dezincification is not a problem, bronze to ASTM B 584 may be used. For valve

stems with a minimum tensile strength of 60,000 psi, a minimum yield strength of 40,000 psi, and an elongation of at least 10 percent in 2 inches, as determined by a test coupon poured from the same ladle from which the valve stems to be furnished are poured.

- H. Protective Coating: Except where otherwise specified, ferrous surfaces, exclusive of stainless steel surfaces, in the water passages of all valves 4-inch and larger, as well as the exterior surfaces of all submerged valves, shall receive a fusion-bonded epoxy coating in accordance with AWWA C550. Flange faces of valves shall not be epoxy coated. The CONTRACTOR, through the valve manufacturer, shall certify in writing that such coating has been applied and tested in the manufacturing plant prior to shipment, in accordance with these Specifications.
- I. Valve Operators: Valves and gates shall be furnished with operators, provided by the valve or gate manufacturer. All operators of a given type shall be furnished by the same manufacturer. All valve operators, regardless of type, shall be installed, adjusted, and tested by the valve manufacturer at the manufacturing plant. Operator orientation shall be verified with the ENGINEER prior to installation. If this requirement is not met, changes to orientation shall be made at no additional cost.
- J. All operators, unless otherwise specified, shall turn counter- clockwise to open. Operators shall have the open direction clearly and permanently marked. All valve operators, shall be provided with the valve by the valve manufacturer. The CONTRACTOR, through the valve manufacturer, shall be solely responsible for the selection of the proper operator to meet the operating conditions specified herein. Field calibration and testing of the operators and valves to ensure proper installation and operation shall be the responsibility of the CONTRACTOR.
- K. All manual operators shall have levers or handwheels, unless otherwise shown. Where buried, the valves shall have extensions with square nuts or floor stands. Valves mounted higher than 6 feet above floor or operating level shall have chain operators. Unless otherwise shown or specified, valves of sizes 4-inch and larger shall have gear-assisted operators.
- L. Operation of valves and gates shall be designed so that the effort required to operate the handwheel, lever or chain shall not exceed 40 pounds applied at the extremity of the wheel or lever. The handwheels on valves 14 inches and smaller shall not be less than 8 inches in diameter, and on valves larger than 14 inches the handwheel shall not be less than 12 inches in diameter.
- M. Chainwheel operator shall be fabricated of malleable iron and pocketed type chainwheels with chain guards and guides. Chainwheel operators shall be marked with an arrow and the word "OPEN" indicating direction to open. Indicators shall be provided at ground level. The operators shall have galvanized smooth welded link type chain. Chain that is crimped or has links with exposed ends shall not be acceptable.
- N. Floor Stands: Floor stands shall be cast iron, non-rising stem type with lockable hand wheel operator, valve position indicator and steel extension stem. Hand wheel shall be lockable in the full closed position. The floor stand shall be furnished with an armored padlock and six keys. Lock shall be as manufactured by Master, Schlage or equal. Floor stand shall be standard pattern type as manufactured by Clow Corporation, or equal.

- O. Valve Labeling: A label shall be provided on all shut-off valves exclusive of hose bibbs and chlorine cylinder valves. The label shall be of 1/16-inch bronze or stainless steel, minimum 2 inches by 4 inches in size, and shall be permanently attached to the valve or on the wall adjacent to the valve or as indicated by the ENGINEER.

2.02 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 Tyler Union, or equal.

PART 3 -- EXECUTION

3.01 VALVE INSTALLATION

- A. General: 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.
- B. All valves, operating units, stem extensions, valve boxes, and accessories shall be installed in accordance with the manufacturer's written instructions and as shown and specified. Valves shall be firmly supported to avoid undue stresses on the pipe.
- B. Access: Install all valves so that operating handwheels or wrenches may be conveniently turned from operating floor but without interfering with access, and and to avoid conflicts between valve operators and structural members or handrails. Unless otherwise approved, install all valves plumb and level. All valves shall be installed to provide easy access for operation, removal, and maintenance.
- C. Valve Accessories: Where combinations of valves, sensors, switches, and controls are specified or shown on the drawings, it shall be the responsibility of the CONTRACTOR to properly assemble and install these various items so that all systems are compatible and operating properly. The relationship between interrelated items shall be clearly noted on shop drawing submittals.
- D. 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.

- E. 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.

- END OF SECTION -

SECTION 15100 – VALVE OPERATORS AND ELECTRIC VALVE ACTUATORS

PART 1 - GENERAL

1.01 THE REQUIREMENT

- A. Equipment shall be provided in accordance with the requirements of Section 11000 – Equipment General Provisions and Section 15000 – Basic Mechanical Requirements.
- B. Reference Section 15390 – Schedules for additional information on valves and operators/actuators.
- C. The electric valve actuators shall meet the requirements described in Division 17. Signal requirements shall be in accordance with Section 17060 – Signal Coordination Requirements, and Section 17920 – Control System Input/Output Schedule.
- D. 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.
- E. 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.
- F. 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. Motorized valves shall be supplied, assembled, and tested as a unit, valve and actuator, by the valve manufacturer, prior to shipping to the site. Documentation of unit responsibility and factory testing shall be submitted for review and approval prior to delivery of the motorized valve assembly to the site.

1.02 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 01300, Submittals; and Section 11000, Equipment General Provisions:
 - 1. A Performance Affidavit shall be submitted for electric actuators in accordance with Section 11000, Equipment General Provisions.
 - 2. Certification that the force required to operate all valves is as specified herein.

1.03 WARRANTY AND GUARANTEE

- A. Warranty and Guarantee shall be as specified in Section 11000 - Equipment General Provisions with the exception that the warranty period shall be, as a minimum, for two (2) years from the date of shipment.

PART 2 -- PRODUCTS

2.01 GENERAL

- A. Electric actuators shall be provided where specified in the Valve Schedule in Section 15390 – Schedules.
- B. 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.
- C. Quarter turn valves 6" and greater in size shall have geared operators. Gate valves 14" and greater in size shall have geared operators.
- D. 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 4-inch shall be lever operated (except gate valves).
 - 3. Exposed valves 6-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 15390 – 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.

2.03 ELECTRIC VALVE ACTUATORS

- A. Electric Actuators shall be open/close service or modulating service as specified in the Valve Schedule in Section 15390 – Schedules.
 - 1. The basis of design for open/close (non-modulating) valve actuators shall be Beck Control Option 3 manufactured by Harold Beck & Sons (BECK), or equal by Rotork.
 - 2. The basis of design for modulating valve actuators shall be Beck Control Option 9 manufactured by Harold Beck & Sons (BECK), or equal by Rotork.
- B. Performance Requirements
 - 1. The actuators shall be designed for indoor and outdoor service and shall be capable of mounting in any position.
 - 2. Torque capacity of the actuators shall be sufficient to operate the valves with the maximum pressure differential, as indicated in the Valve Schedule in Section 15390 – Schedules plus a safety factor of 1.5. Actuators in modulating service shall be selected such that the required maximum valve torque is no more than 60 percent of the electric actuator's maximum rated torque.
 - 3. Operating time for full limits of travel shall be 2 seconds per inch diameter of the valve, +/- 50 percent through 20 inches; +/- 30 percent for valves 24 inches and larger. Operating time for full limits of travel shall not be less than 60 seconds for all modulating valves.
 - 4. Actuators shall be capable of operating in ambient temperatures ranging from -22 degrees F to +158 degrees F.
 - 5. For open/close (non-modulating) actuators, the gearing, motor and solid-state reversing starter shall be capable of up to 60 starts per hour without overheating.

6. For modulating actuators, the gearing, motor and contactor shall be capable of up to 1200 starts per hour without overheating. Design of the motor shall be such that electrical and thermal overloads are not required.
7. It shall be possible to carry out the setting of the torque, turns and configuration of the indication contacts without the necessity to remove any electrical compartment covers. A setting tool shall be included for non-intrusive set-up, calibration, and interrogation of the actuator.

C. Mechanical Modulating Actuators

1. Rotary actuators shall be Series 11 with DCM control module, directly coupled to the valve. The drive shall be supplied with either 480/3/60 or 120/1/60 AC power. Actuators shall have 120 Volt, single phase, 60 Hz AC, TENV, permanent magnet, synchronous, inductor motors with NEMA Class F insulation minimum (Class H for modulating actuators) and be specifically designed for modulating service as specified. Beck actuators with a 480/3/60 power supply shall have an internal transformer to step the power down to 120/1/60 for the motor. Motor shall be non-coasting, suitable for high duty cycle conditions, and shall be self-locking and self-releasing without the use of a separate brake winding, mechanical brake, or worm gear mechanism. Triacs shall be utilized for solid-state switching. Maximum current draw of motors shall be 3.1 amperes in a fully stalled condition. Motors shall reach synchronous speed on start-up in 1.5 AC power cycles and shall also reach dead stop from full synchronous speed in 1.5 cycles. Motor shall not overheat or fail when in cumulative stall condition for 72 hours. No electrical or thermal overload protection shall be required for protection of a stalled or cycling operator.
2. Control drive shall be designed to stay in place upon loss of power and shall be capable of holding a load equal to at least 200% of the model's rated output. Stall torque shall be self-limiting not exceeding 2.5 times the rated torque. Torque switches shall not be required. Drive shall operate on an increasing signal for full 100° rotation. Control drives shall be able to operate in any mounting orientation.
3. Gear train shall have high efficiency spur gears constructed of heat treated alloy steel or ductile iron only. Readily available gear modules shall provide for a range of torque and timing combinations within the drive's rated capacity and shall be field-interchangeable. Gears shall be rated at twice the output torque of the operator, so that a cumulative stall condition of 72 hours will not create any significant wear or performance degradation. To protect against accumulative stall damage in Auto mode, the drive should automatically discontinue motor operation when the motor current is detected to be flowing in the same direction for 300 seconds. Over-travel of operator shall be prevented by internal mechanical stops cast into the operator. Operating time between full limits of travel shall be no greater than 180 seconds.
4. Motor pinion and all gearing shall be lubricated with a premium, heavy-duty lithium based lubricant, and shall not require changing of the lubrication for a minimum of five years. No oil baths shall be used for lubrication purposes. Maintenance-free bearings shall be used.

5. A low-speed, disc-type motor, solid handwheel shall be provided, directly connected to the motor's rotor, for manual operation. A mechanical indicator of valve position shall be provided and attached to the main output shaft driving the load. No declutching mechanism shall be required for manual operation.
6. Linkage between operator and valve shall be by crank arms and connecting rod, with adjustable starting point of valve position and adjustable rod length. Operators shall stop precisely within 0.15 degrees of the desired control position. Operator output shaft shall be stainless steel. Stem shall be self-locking when the motor is de-energized. Modular construction and special lubrication shall permit the operator to be mounted in any position. Modulating operators shall be capable of operating in ambient temperatures ranging from -40°F to 185°F.
7. Operators shall be provided with four individual compartments for the motor, gearing, wiring terminals, and auxiliary switches plus position sensing device. Compartments shall be provided with moisture and dust-proof rigid cast covers. All switches, wiring, relays, etc., shall be brought to a gasketed and sealed terminal board for field connection. A minimum of two 3/4-inch NPT conduit entries shall be furnished. Conduit shall be run properly to avoid water ingress to the compartments. The motor shall have electrical connections soldered directly to the wiring terminal block where appropriate. Double lipped grease seals shall be provided on the handwheel and output shafts for weatherproof protection.
8. Two SPDT limit switches for over-travel protection and four auxiliary SPDT limit switches (two normally open, two normally closed) shall be provided on all operators. Limit switches shall be snap-acting, SPDT, rated for 6 amperes at 120 VAC. Switches shall be infinitely adjustable over the full range of valve travel. Limit switches shall be wired to a terminal board for remote output. Drive shall also have integral mechanical stops, capable of limiting travel of the drive and load, with or without the drive motor.
9. The operators for the modulating valves shall be provide 4-20 mA output signals for valve position feedback. Continuous position sensing of valve position shall be provided. Position sensing shall require no contacting or wiping surface. The position sensing unit shall be provided integral with the operator and shall provide a linear 4-20 mA output signal, approximately proportional to valve percent open.
10. Modulating valve actuators shall have a position feedback circuit designed to respond to a 4-20mADC signal and shall be provided with a valve positioner that shall position the valve proportional to an externally generated 4-20mADC signal. The valve positioning control circuitry shall position the valve, in steps down to 0.15°, by comparing the command signal with the present valve position as indicated by the feedback rotary variable differential transformer (RVDT) mechanism. The control circuitry shall be field adjustable to fail to the "open," "closed," or "last" position on loss of 4-20 mADC command signal.
11. Actuators shall contain wiring and terminals for the following control functions. All dry contacts shall be rated for 6A at 120VAC.

- a. Modulating valve actuators shall be designed to respond to a 4-20mADC analog signal as specified herein or as required to coordinate with the requirements of Division 17.
 - b. A five-position, drive-mounted electric handswitch shall be provided to permit local electrical operation of the unit for control adjustment or operation on loss of control signal.
 - c. Four (4) unpowered contacts shall be provided, three of which shall be selected to indicate valve "Opened" position, valve "Closed" position, and "In Remote" status of the actuator. "Malfunction" status of the actuator shall be monitored from a separate terminal. In normal operation, this terminal shall not be energized. The "Malfunction" contact shall activate upon a stall condition, motor overtemperature, or loss of signal event, minimally.
 - d. Where required in the Valve Schedule in Section 15390 – Schedules, the actuator must be wired to interface with a remote manual control station.
- 12. Contractor shall coordinate control and wiring per Division 17.
 - 13. Certified electrical control schematic diagrams shall be provided by the actuator Manufacturer for each service type of electric actuator. Interconnecting wiring information shall be submitted including terminal numbers, color coding, and the name and terminal numbers, for items to which the wiring is to be connected.
 - 14. Enclosure shall be totally enclosed, cast, weatherproof, dust-tight, NEMA 4X rated. Separate conduit entrances shall be available for power and control wiring connections.

D. Local Controls

- 1. A five-position, drive-mounted electric handswitch shall be provided to permit local electrical operation of the unit for control adjustment or operation on loss of control signal. All switches, wiring, relays, etc. shall be brought to a terminal board for field connection.
 - a. When the handswitch is in the "Auto" position, the actuator shall be controlled by remote control signals. Operators for modulating service shall be provided with integral position controllers which shall receive a 4-20 mA setpoint signal and, while in "Auto" mode, shall position the valve to match the setpoint.
 - b. When the handswitch is in the "CW" or "CCW" position, the actuator shall move toward the appropriate end-of-travel limit switch. Placing the selector switch in the "Stop" position shall stop the actuator travel.

E. Remote Manual Control Station

- 1. Where indicated in the Valve Schedule in Section 15390 – Schedules, manual actuator controls shall be furnished in a separate NEMA 4X stainless steel enclosure (NEMA 7 if located in a classified area). Manual control station controls

shall include Hand–Off-Auto Selector switch; Open, Stop, and Close pushbuttons; a red lamp indicating closed and a green lamp indicating open.

- a. When the HOA is in the “Hand” position, open/close control shall be by the open and close pushbuttons on the remote manual control station. The stop push button shall stop actuator travel.
- b. When the HOA is in the “Off” position, the actuator shall not operate.
- c. When the HOA is in the “Auto” position, the actuator shall be controlled by remote inputs to the valve actuator from the PLC.

F. Actuator I/O Signals: The following minimum analog and discrete I/O shall be made available in the actuator to display the actuator status and alarms as the following:

1. Valve position (0-100 percent) 4-20 mA analog input
2. Valve position command (0-100 percent) 4-20 mA analog output
3. IN REMOTE selected
4. MALFUNCTION alarm

2.04 ELECTRIC OPERATORS FOR PVC/CPVC VALVES

- A. Automatic electric operators shall be provided for PVC/CPVC valves where specified and/or as shown on the Drawings. Operators shall operate on 120 volt AC, single phase, 60 hertz power and be equipped with solid state electronic internal controls. Motors shall be brushless, capacitor-run, reversing type, suitable for high duty cycle applications and shall be specifically designed for open/close service. Motors shall be provided with integral thermal overload protection with auto-reset. Operator gears and shafts shall be constructed of heat treated high-alloy steel. Operator output shaft shall be electro-less nickel plated. Operator gear trains shall be permanently lubricated. The gear train shall withstand operator stall torque. Operator enclosures shall be NEMA 4. Operators shall be provided with internally wired, thermostatically controlled enclosure heaters to maintain an enclosure temperature of at least 40 degrees F. Operators shall be provided with positive visual position indication markings permanently affixed to the operator body and final output shaft. Operator drive output shall be provided with a declutchable manual override. A manual lever shall be provided for manual valve positioning. Operators shall be failsafe, utilizing a mechanical spring with a clutch mechanism to uncouple the motor during spring return operation, allowing the spring to relax and either open or close the valve. Selection of either fail-opened or fail-closed shall be made by selection of field wiring terminals.
- B. Independently adjustable cam-operated position limit switches shall be provided with dry contacts for remote fully opened and fully closed valve position indication. Operators shall respond to external dry contact open/close controls. The actuator shall have internal latching circuitry that causes the operator to drive the valve to its limit of travel upon receipt of the momentary contact open or close signal unless a stop signal is received. The all actuator control circuitry, including latching circuitry, shall be internal to the valve actuator. Valve control circuits and components mounted in a separate

enclosure external to the valve actuator assembly will not be permitted. Connections for external remote controls shall be powered from an internal 24VDC or 120VAC power supply. Limit switches shall be rated for 15 amps at 120 VAC. Valve remote status shall also be provided as specified in Section 17950. The Contractor shall coordinate operator controls with the functional requirements specified in Section 17950 – Functional Control Descriptions.

2.05 SPARE PARTS

- A. Spare parts shall be provided in accordance with Section 11000, Equipment General Provisions and shall include, but not be limited to, the following:
- One complete set of field replaceable electric-electronic parts
 - One O-Ring Seal Kit for each motor actuator provided

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 11000, Equipment General Provisions and shall include the following site visits for electric actuators:

Service	Number of Trips	Number of Days/Trip
Installation and Testing	2	2
Startup and Training	4	4

3.02 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.

3.03 SHOP TESTING

- A. Shop testing shall be in accordance with Section 11000, Equipment General Provisions and with the following additional requirements:
1. Conduct a complete functional check of each unit. Correct any deficiencies found in shop testing prior to shipment.
 2. Submit written certification that:
 - a. Shop tests for the electrical system and all controls were successfully conducted;

- b. Electrical system and all controls provide the functions specified and required for proper operation of the valve operator system.
- 3. Each actuator shall be performance tested and individual test certificates shall be supplied free of charge. The test equipment shall simulate each typical valve load and the following parameters should be recorded:
 - a. Current at maximum torque setting
 - b. Torque at maximum torque setting
 - c. Flash Test Voltage
 - d. Actuator Output Speed or Operating Time
 - e. In addition, the test certificate should record details of specification, such as gear ratios for both manual and automatic drive, closing direction, and wiring diagram code number.
 - f. Verification of actuator torque rating with valve.

3.04 FIELD TESTS

- A. Field testing shall be in accordance with Section 11000, Equipment General Provisions and with the following additional requirements:
 - 1. Valve actuators shall be field-tested together with the associated valves.
 - 2. Test all valves at the operating pressures at which the particular line will be used.
 - 3. Test all valves for control operation as directed.
 - 4. Field testing shall include optimization of opening and closing times of the valves. 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.
- B. 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.

C. 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 11000.

- END OF SECTION -

SECTION 15104 - BALL VALVES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The CONTRACTOR shall furnish and install ball valves, complete and operable, as shown and specified herein, including epoxy coating, appurtenances, operators, and accessories, all in accordance with the requirements of the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 15095 - Valves, General

1.03 SUBMITTALS

- A. Shop Drawings: Submit shop drawings in accordance with the section entitled "Submittals." The shop drawings shall include the following:
 - 1. Manufacturer's standard literature.
 - 2. Dimension drawings for all valves to be supplied.
 - 3. Valve manufacture's recommended instructions for joining the valves and piping.
- B. Operation and Maintenance Manuals: Submit operation and maintenance manuals in accordance with the section entitled "Submittals".

PART 2 -- PRODUCTS

2.01 PLASTIC BALL VALVES

- A. Plastic ball valves shall be used at all PVC pipe installations where required, and be made of polyvinyl chloride (PVC) or chlorinated polyvinyl chloride (CPVC) as recommended by the Supplier for any specific applications. PVC shall be Class 12454-B or better, conforming to resin specification ASTM D1784. CPVC shall be Class 23447-B or better, conforming to resin specification ASTM D1784. All valves shall have manual operators, unless otherwise specified or shown.
- B. All plastic ball valves shall have socket true union ends or flanged ends to ANSI B 16.5, class 150, for easy removal. The balls shall have full size ports and PTFE seats and shall be polished free of any imperfections. PTFE seats shall have elastomeric backing cushion of the same material as the valve seals. All body seals, union O-ring seals, and stem seals shall be Viton. The valves shall be suitable for a maximum working non-shock pressure of 230 psi at 73 degrees F for sizes ½" through 2" and 150 psi at 73 degrees F for sizes 2-1/2" through 6". The handle shall incorporate a tool for adjustment of the seat carrier.
- C. Suppliers or Equal

1. ASAHI-America;
2. IPEX;
3. Plast-o-matic.

2.02 STAINLESS STEEL BALL VALVES

- A. Ball valves for use with stainless steel piping systems, including instrument isolation, air lines, and moisture drains shall be end entry type with type 316 stainless steel body and trim, Teflon seats and seals and flanged or threaded connections as indicated. Valve body shall be either two or three piece design, no internal ring for the ball shall be acceptable. Valves shall be class 150.
- B. Valves shall be supplied with stainless steel manual lever or "T" handle. Valves used as moisture drain valves shall be installed at low points of the line and piped to drain.
- C. Suppliers, or Equal
 1. Jamesbury Corporation;
 2. Jenkins Bros.;
 3. Lunkenheimer Flow Control;
 4. Wm. Powell Company;
 5. Worcester Controls.

PART 3 -- EXECUTION

3.01 GENERAL

- A. All valves shall be installed in accordance with provisions of Section 15095 entitled "Valves, General." Care shall be taken that all valves in plastic lines are well supported on each end of the valve.
- B. All valves shall be tested to unidirectional or bi-directional shut-off as required by service conditions.

- END OF SECTION -

SECTION 15105 – CHECK VALVES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The CONTRACTOR shall furnish and install all check valves in the types and sizes shown and specified, complete and operable, including epoxy coating, appurtenances, and accessories, in accordance with the requirements of the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 15095 - Valves, General.

PART 2 -- PRODUCTS

2.01 SWING CHECK VALVES (3-INCH AND LARGER) FOR LIQUID SERVICE

- A. Unless otherwise indicated or specified, check valves 3-inches and larger shall be cushion swing check with outside lever and weights in accordance with AWWA C 508. Valves shall have flanged ends faced and drilled in accordance with ANSI B16.1 Class 125 or Class 250. Check valves shall have cast iron bodies conforming to ASTM A126, with the following components of stainless steel: body ring, disc ring, clapper hinge shaft and assembly, shaft key, clapper spacers, disc stud, disc stud nut and bushing, disc retaining washer and cotter pin. The hinge pin shall extend outside the cast iron body through lubricated stainless steel bushings and outside packed glands on each side of the valve. Each bushing shall be provided with a buttonhead grease fitting. Stainless steel shall be at least 18-8 nickel-chromium content. Check valves shall be provided with packing around the valve stems of material compatible with the fluid application. Check valves shall be tested at the factory and shall be drip tight under a hydrostatic pressure of 200 psi applied to the downstream side of the disc. A certified test report shall be furnished with each valve.

- B. Suppliers, or Equal

1. Clow
2. G.A. Industries

2.02 SWING CHECK VALVES (2-1/2-INCH AND SMALLER) FOR LIQUID SERVICE

- A. Swing check valves for steam, water, oil, or gas in sizes 2-1/2-inch and smaller shall be suitable for a steam pressure of 150 psi and a cold water pressure of 300 psi. They shall have screwed ends, unless otherwise shown, and screwed caps.
- B. The valve body and cap shall be of bronze to ASTM B 61 with threaded ends to ANSI/ASME B1.20.1.
- C. Valves for steam service shall have bronze discs, and for cold water, oil, and gas service replaceable composition discs.

- D. The hinge pins shall be of bronze or stainless steel.
- E. Suppliers or Equal

- 1. Crane Company.
- 2. Milwaukee Valve Company.
- 3. Stockham Valves and Fittings.
- 4. Val-Matic.
- 5. APCO; Series 800T.

2.03 SWING CHECK VALVES (PVC/CPVC)

- A. Swing check valves (PVC/CPVC) shall be constructed of solid Class 12454-B PVC or Class 23447-B CPVC with Teflon seats and seals. Valves shall have an external lever and weight. Check valves shall have flanged ends. Valves shall be capable of top entry to facilitate cleaning and repair without removal from the line. Valve shall incorporate a single disc design. Check valves shall be as manufactured by ASAHI/AMERICA, or equal.

2.05 BALL CHECK VALVES (PVC/CPVC)

- A. Ball check valves (PVC/CPVC) shall be constructed of solid Class 12454-B PVC or Class 23447-B CPVC with Viton seats and seals, as manufactured by Chemtrol Products Division of NIBCO, Inc., or equal. Valves shall be furnished with threaded ends and shall be true union type. Valves shall have 150 psi minimum non-shock cold water pressure rating and integral union with screwed ends or as specified otherwise.

2.06 LIMIT SWITCHES

- A. Where indicated, an oil-tight limit switch and mounting bracket shall be supplied by the check valve manufacturer and shall be installed by the CONTRACTOR on each pump discharge swing check valve. The length of the limit switch actuating arm shall be at least equal to the nominal diameter of the check valve.
- B. The check valve limit switch shall be mounted horizontally.
- C. The limit switch shall be a precision plunger type with a differential of 1/10" or less. The limit switch shall sense when the check valve is partially open or fully closed, and shall provide a signal to the pump control logic to convey the status of check valve closure.
- D. Limit switch contact rating shall be 10 amps at 120 V AC.

PART 3 -- EXECUTION

3.01 GENERAL

- A. All valves shall be installed in accordance with provisions of the Section titled, "Valves, General."

- B. All valve exteriors shall be painted as specified in Section 09900, Painting. All exposed interior corrosive ferrous surfaces of valves 4 inches and larger, as well as the exterior surfaces of buried valves, shall receive a fusion bonded epoxy coating conforming to AWWA C550.

- END OF SECTION -

SECTION 15109 - PLUG VALVES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The CONTRACTOR shall furnish and install plug valves, complete and operable, as shown on the Drawings and as specified herein including operators, protective coatings, and appurtenant work, all in accordance with the requirements of the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 15095 - Valves, General.
- B. Section 15100 – Valve Operators and Electric Valve Actuators.

PART 2 -- PRODUCTS

2.01 PLUG VALVES

- A. Eccentric Plug Valves 3"-36" shall meet or exceed the latest revision of AWWA Standard C517, and shall meet or exceed the requirements of this specification. Plug valves shall be of the non-lubricated, eccentric seating plug type with synthetic rubber-faced plugs as manufactured by DeZurik Company. Valves shall be PEF 100% port area, unless otherwise specified herein or indicated in the appropriate Valve Schedule in Section 15390, Schedules. All valves shall be provided with limit stops and rotate 90° from fully open to fully shut. The minimum working pressure for all valves shall be 150 psi, and the test pressure shall be at least 270 psi for valves up through 12-inch and at least 230 psi for valves 14-inch and larger. The body materials shall be of epoxy coated cast iron or semi-steel, unless specified otherwise. Seats shall have a welded overlay of 90 percent pure nickel and machined to a finish containing no stress cracks. Plug facings shall be of Hycar, or equal and completely suitable for use with domestic sewage.
- B. Full port (100% of full pipe area) plug valves shall be furnished for all sludge applications.
- C. The shaft seal shall be either the bronze cartridge type with at least two O-Rings, monolithic V-Type, or pull down packing type. If monolithic V-Type or pull down packings are utilized, it shall be self-adjusting, self-compensating type. Packing shall be as Chevron Type, or equal. Plug valves with pull down packings shall be designed with an extension bonnet so that repacking can be done without removal of the actuator.
- D. All buried valves shall have mechanical joint ends (unless otherwise shown), conforming to AWWA C111, and shall be operated with a standard AWWA 2-inch square nut through a totally enclosed worm gear actuator. Valve boxes shall be installed with all buried plug valves and shall be as specified herein.
- D. Unless otherwise shown, all exposed valves 4-inches in diameter and larger shall have flanged ends conforming to ASME B16.1-125/150 pound standard with face-to-face

dimensions of standard plug valves. Valves smaller than 4-inches in diameter shall have screwed ends, unless otherwise noted.

- E. Valves 6-inches in diameter and larger shall be handwheel or floorstand operated where required or indicated on the Drawings through totally enclosed worm gear actuators, unless otherwise specified or shown on the Drawings. Valves 6-inches in diameter and smaller shall have lever operators, unless otherwise specified or noted on the Drawings. Manual operators for plug valves mounted above 6 feet from the operating floor shall be equipped with worm gear chainwheel actuators. Electric, electrohydraulic and pneumatic actuators shall be mounted to the valve by the valve supplier.
- F. The manufacturer shall certify that the plug valves are capable of operating in continuous duty service under these pressures and flow conditions.
- G. Each valve shall be hydrostatically tested and tested for bubble tightness after the operator has been mounted and adjusted. Copies of the hydrostatic and leakage test certification and certification of conformance shall be submitted to the ENGINEER prior to shipment.
- 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.

2.02 MOTORIZED VALVE ACTUATORS

- A. Where scheduled or shown on the Drawings, plug valves shall be fitted with a motorized actuator for remote and automated operation of the valve. Motorized valves shall be supplied, assembled, and tested as a unit, valve and actuator, by the valve manufacturer, prior to shipping to the site. Documentation of unit responsibility and factory testing shall be submitted for review and approval prior to delivery of the motorized valve assembly to the site.
- B. Refer to Section 15100 – Valve Operators and Electric Valve Actuators.

PART 3 -- EXECUTION

3.01 INSTALLATION

- A. All plug valves shall be installed in strict accordance with the Supplier's published recommendations and the applicable provisions of the Section, titled "Valves, General".

- END OF SECTION -

SECTION 15110 – PINCH VALVES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The CONTRACTOR shall furnish and install pinch valves, complete and operable, as shown on the Drawings and as specified herein including operators, protective coatings, and appurtenant work, all in accordance with the requirements of the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 15095 - Valves, General
- B. Section 15100 – Valve Operators and Electric Valve Actuators

PART 2 -- PRODUCTS

2.01 PINCH VALVES

- A. Valves shall be of flanged cast iron construction, fully gasketed, with end flanges drilled to Class 125 ANSI/ASME B 16.1. Port area shall be 100 percent of the full pipe area through the entire length of the sleeve. The pinch tube shall be one piece construction of Buna-N with integral flanges drilled to be retained by the flange bolts. The pinch tube shall be reinforced with calendared nylon. All internal valve metal parts are to be completely isolated from the product line by the flexible elastomer pinch tube. Valves shall be suitable for bi-directional service and drop tight shut off at 100 degrees F and 100 psi working pressure.
- B. The pinch mechanism shall be supported in the valve body. The pinch mechanism and side rails shall be fully enclosed within the valve body. The mechanism shall be connected to the electric actuator through an ACME threaded stem. The pinch mechanism shall be fully adjustable for stroke without removing the valve from the line.
- C. Pinch valves shall be manufactured by Red Valve, Series 5200 or Equal.
- D. All 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.

2.02 ELECTRIC MOTOR OPERATOR

- A. Pinch valves shall be provided with modulating electric actuators, furnished and sized by the valve manufacturer as a complete package. The electric actuator shall be mounted on the valve by means of an open yoke. The electric actuator and yoke shall be non-rising.
- B. Modulating electric actuator shall be manufactured by Rotork, or Harold Beck & Sons (BECK).

- C. Actuator shall achieve a valve open travel time from 0% to 100% of no less than 60 seconds.
- D. Actuators shall be designed for indoor and outdoor service and shall be capable of mounting in any position. Actuators shall be capable of operating in ambient temperatures ranging from -20 degrees F to +150 degrees F.
- E. Torque capacity of the actuators shall be sufficient to operate the valves with the maximum pressure differential plus a safety factor of 1.5. Actuators in modulating service shall be selected such that the required maximum valve torque is no more than 60% of the electric actuator's maximum rated torque.
- F. It shall be possible to carry out the setting of the torque, turns and configuration of the indication contacts without the necessity to remove any electrical compartment covers. A setting tool shall be included for non-intrusive set-up, calibration, and interrogation of the actuator.
- G. The actuators shall include one integral housing, individual compartments for the motor, gearing, wiring terminals and control circuits. Enclosure shall be NEMA 4X.
- H. All gearing shall be hardened alloy steel or bronze and shall be rated at twice the output torque of the operator and shall be designed to withstand the stall torque of the motor without failure.
- I. A mechanical indicator on the gear box and digital position indicator shall be furnished to continuously indicate the position of the valve at and between the fully open and fully closed positions. The mechanical indicator shall be driven by gearing driven off of the main worm gear pinion and shall operate when the actuator is in either the electrical mode or manual mode. The digital indicator shall display valve position, with or without its power supply.
- J. A handwheel shall be permanently attached for manual operation. A gear assembly shall be provided between the handwheel and the worm shaft if required to reduce the force necessary to operate the handwheel to less than 80 pounds. A positive declutch mechanism shall engage the handwheel when required. When the actuator is set in the declutched position for handwheel operation, it shall return automatically to electric operation when the actuator motor is energized. The handwheel shall not rotate during electric operation nor shall a ceased motor prevent handwheel operation.
- K. Actuators shall contain wiring and terminals for the following control functions. All dry contacts shall be rated for 5A at 120VAC.
 - 1. Open, Close, and Stop commands from external dry contacts (utilizing internal 24VDC 120VAC power supply) and/or from an external signal of 20V to 120V. The inputs for the open, close, stop signals shall be field selectable to be respond to either maintained or momentary remote signals. In momentary mode, the actuator shall have internal latching circuitry that causes the operator to drive the valve to its limit of travel upon receipt of the momentary contact signal unless a stop signal is received.

2. Emergency override input from a normally closed or normally open contact. The actuator shall either open or close (field selectable) upon receiving the emergency override input.
 3. Remote Local-Off-Remote selector switch, Open/Close pushbuttons, and Open/Closed pilot lights for a remote manual control station (see below). The remote Local-Off-Remote selector switch and Open/Close pushbuttons shall be a dry contact input to the actuator control circuitry. The Open/Closed pilot lights shall be powered from the valve actuator control power. A red lamp shall indicate closed and a green lamp shall indicate open.
 4. Four (4) unpowered contacts shall be provided which can be selected to indicate valve "Opened" and "Closed" position, "Remote" status of the actuator, and "Fail" status of the actuator. The fail status contacts shall activate upon motor overtemperature, phase-loss and actuator overtorque (minimum).
 5. Terminals for 4-20mADC position command and 4-20mADC position feedback
- L. Modulating actuators shall have a position feedback circuit. The feedback position signal shall be a 4-20 mA signal corresponding to valve position. Modulating valve actuators shall be designed to respond to a 4-20mADC analog signal and shall be provided with a valve positioner which shall position the valve proportional to the externally generated 4-20mADC signal. Deadband for 4-20mADC analog input signal shall be 1% or less. Deadband shall be configured prior to startup.
- M. Actuators shall be suitable for single phase, 120VAC power with totally enclosed motors, minimum Class F insulation. Actuators shall be furnished with reversing starters.

2.03 SPARE PARTS

- A. Spare parts shall be provided in accordance with Section 11000, Equipment General Provisions and shall include, but not be limited to, the following:
- One (1) O-ring seal kit for electric actuator
 - One (1) pinch tube

PART 3 -- EXECUTION

3.01 INSTALLATION

- A. All pinch valves shall be installed in strict accordance with the Supplier's published recommendations and the applicable provisions of the Section, titled "Valves, General".

3.02 MANUFACTURER'S FIELD SERVICES

- A. The services of a qualified manufacturer's technical representative shall be provided in accordance with Section 11000 and shall include the following site visits:
1. Installation and testing – one trip of one day

2. Startup and training – one trip of one day

- END OF SECTION -

SECTION 15114 - MISCELLANEOUS VALVES AND APPURTENANCES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. Reference Section 15000, Basic Mechanical Requirements.

PART 2 -- PRODUCTS

2.01 GATE VALVES (SMALLER THAN 4-INCH)

- A. Gate valves, smaller than 4-inch, for general purpose use shall be heavy duty type for industrial service, with screwed or soldered ends to suit piping. The bodies shall have screwed tops or union bonnets, of bronze to ASTM B 62, with bronze stems, solid wedges, metal handwheels, and Teflon-impregnated or other acceptable packing. Buried valves shall have non-rising stems. Exposed valves (above ground) shall have rising stems. All valves shall have a minimum pressure rating of 125 psi.
- B. Suppliers, or Equal:
 - 1. Crane Company;
 - 2. Milwaukee Valve Company;
 - 3. Wm. Powell Company.

2.02 SERVICE SADDLES

- A. Service pipe saddle shall fit to the maximum O.D. of the saddle's range, and extend a minimum of 160 degrees around the pipe. When the saddle is used on pipe to the minimum pipe size of the range, the saddle shall extend 180 degrees around the pipe. Straps shall have ends chamfered and be provided with Class 2 fit, National Coarse Threads. Saddle casting shall be ductile iron, double strap and shall have asphaltic coating. Straps shall be stainless steel. Valve gaskets shall be self sealing, neoprene.

2.03 CORPORATION STOPS

- A. Corporation stops shall be provided with all service saddle connections. Corporation stops shall be O-ring sealed, balance pressure, plug type valves having a full open unobstructed flow way. Corporation stops shall have threaded inlet and outlet connections unless otherwise indicated and shall be suitable for buried service where required. Corporation stops shall be manufactured of brass alloys containing less than 0.25% lead.
- B. The suppliers shall be the following or equal:
 - 1. Ford Meter Box Company;

2. James Jones Company;
3. Mueller Company.

2.03 SOLENOID VALVES

- A. Three-way two-position solenoid valves shall be of the two coil type. Both coils shall be normally closed and each shall open independently when energized. The valve shall be of forged brass-body and bonnet with a Buna "N" diaphragm and screwed ends. The solenoid's internal parts shall be of 300 and 400 series stainless steel. The valve shall have a safe body working pressure of 125 psi and shall be as manufactured by ASCO Valves, Automatic Switch Co., or equal, for 120V, 60 Hz, single phase operation. Solenoid enclosure shall be NEMA 4 watertight.
- B. Two-way solenoid valves shall be normally closed and shall open when the solenoid is energized, unless otherwise noted. The valve shall be of forged brass-body and bonnet with a BUNA "N" diaphragm and screwed ends. The solenoid's internal parts shall be of 300 and 400 series stainless steel. The valve shall have a safe body working pressure of 125 psi, and shall be as manufactured by ASCO Valves, Automatic Switch Co., or equal, for 120 volt, 60 Hz, single phase operation. Solenoid enclosure shall be NEMA 4 watertight.
- C. Four-way two-position solenoid valves shall be of the single coil type and shall be normally closed and shall open when the solenoid is energized (i.e. fail closed). The remainder of the four-way two-position solenoid valves shall be of the two coil type. Both coils shall be normally closed and each shall open independently when energized. The valve shall be of forged brass-body and bonnet with a Buna "N" diaphragm and screwed ends. The solenoid's internal parts shall be of 300 and 400 series stainless steel. The valve shall have a safe body working pressure of 125 psi and shall be as manufactured by ASCO Valves, Automatic Switch Co. or equal, for 120V, 60 Hz, single phase operation. Solenoid enclosure shall be NEMA 4 watertight. The solenoid valve shall be provided with a manual override.

2.02 SEWAGE AIR RELEASE VALVES

- A. The Contractor shall furnish and install sewage air release valves where indicated on the Drawings and specified herein. Air release valves for sewage shall have elongated, cylindrical chambers designed to release entrained air and sewage gases through an air release orifice. The air release valve float shall withstand an external pressure of 500 psi without collapsing.
- B. After entraining air escapes through the orifice, the orifice shall be closed by a needle on a compound lever mechanism to prevent the escape of sewage. The orifice shall remain closed until more gas accumulates and the cycle automatically repeats. The valve shall seat to prevent sewage from leaking through the valve at any pressure. Valves shall have an operating pressure of at least 150 psi.
- C. Air release valves shall be provided with a ½" diameter orifice and each valve shall be provided with an isolation valve, quick disconnect coupling and valve for back flushing, and a blow off outlet and valve at the bottom of the chamber.

D. Materials of construction shall be as follows:

- | | |
|-------------------------------|---|
| 1. Body | Cast Iron: ASTM A 126 Grade B or
Ductile Iron: ASTM A536 |
| 2. Internal Linkage and Float | Stainless Steel: Type 316 |
| 3. Needle | Buna-N |

- E. Sewage air release valves shall have inlets of the type and diameter as shown on the Drawings. If not identified, sewage air release valves shall be provided with a 2-inch (minimum) threaded connection.
- F. 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 (NSF approved) epoxy for corrosion resistance. Damaged surfaces shall be repaired in accordance with the manufacturer's recommendations.
- G. Sewage air release valves shall be APCO Series 450 or equivalent as manufactured by ARI, Crispin (S Series), Val-Matic (49A.4 – 49A.6), or equal.

2.03 NEEDLE VALVES

- A. Needle valves shall be bronze body and spindle with follower gland and shall be 400 psi, non-shock cold water needle valves, Figure 743-G as manufactured by Jenkins Bros., Corp., Crane Co. No. 88, or equal.
- B. Needle valves (service air) shall be bronze body, with stainless steel stem. Valves shall be Jenkins Valve Fig. 741G, Crane Co. or equal and shall have minimum 400 psi non-shock cold water pressure rating and screwed ends.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. All valves shall be installed in accordance with the manufacturer's printed recommendations and the requirements of Section entitled "Valves, General".

- END OF SECTION -

SECTION 15390 - SCHEDULES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. Reference Section 15000, Basic Mechanical Requirements.

1.02 PIPING SYSTEM SCHEDULES

- A. Piping requirements for this Section are outlined on the Drawings, and in the Piping System Schedule. In the absence of a specified test pressure, pipe shall be tested at a pressure 50 percent greater than the normal operating pressure as determined by the ENGINEER or 10 psig, whichever is greater unless the Schedule indicates that no test is required.
- B. If the pipe material is not shown on the Piping System 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)	53	(1)
4-inch through 24 inch	DIP	Restrained (Buried)	Pressure Class 350	(1)
30 inch and greater	DIP	Restrained (Buried)	Pressure Class 300	(1)
Less than 4-in	PVC	Socket	Sch 80	(1)

(1) Test at 150 percent of normal operating pressure or 10 psi, whichever is greater.

- C. Non-critical gravity lines such as drains, floor drains, roof drains, etc., do not typically require a pressure test.

1.03 PIPING SCHEDULE ABBREVIATIONS

- A. Material
- 316 SS
 - 316 Stainless Steel (non-welded joints) or
 - 316L Stainless Steel low carbon (welded joints)
 - DI
 - Ductile Iron
 - PVC
 - Polyvinylchloride
 - SS
 - Stainless Steel
- B. Thickness, Class or Schedule
- CL
 - Class
 - Sch
 - Schedule

- C. Type of Joints
- Flg - Flanged
 - MJ - Mechanical Joint
 - RJ - Restrained Joint
 - SW - Solvent Welded
 - Thd - Threaded
 - Wld - Welded
- D. Type of Fittings
- 316L SS - 316L Stainless Steel
 - DI - Ductile Iron
 - PVC - Polyvinylchloride
 - SS - Stainless Steel
- E. Interior Protective Coating
- ACCL - Asphalt Coated Cement Lined
 - EL - Epoxy Lined
 - PE - Polyethylene Lined
- F. Exterior Protective Coating
- AC - Asphalt Coated
 - P - Painted
 - Gal - Galvanized
 - PE - Polyethylene Encased

1.04 PIPING SCHEDULE

Service	Nominal Pipe Diameter (Inches)	Material	Thickness Class or Schedule	Working Pressure (PSIG)	Test Pressure (PSIG)	Type of Joints	Type of Fittings	Protective Coating		Remarks
								Interior	Exterior	
RAS Piping										
Above Ground	12 inches and over	DI	CL 53	30	150	Flg	DI	EL	P	Note 1
Below Ground	12 inches and over	DI	CL 53	30	150	RJ	DI	EL	AC	Note 1
Clarifier Drain Piping	12 inches and over	DI	CL 53	30	150	RJ	DI	EL	AC	
WAS Piping	4 inches and over	DI	CL 53	30	150	Flg	DI	EL	P	
Sample Piping	3 inch and less	PVC	Sch 80	80	100	SW	PVC	--	P	
Process Drain Piping	3 inch and less	PVC	Sch 80	80	100	SW	PVC	--	P	
Seal Water Piping	3 inch and less	PVC	Sch 80	80	100	SW	PVC	--	P	
ARV Gauge Assembly Piping	3 inch and less	Type 316L SS	Sch 40S	80	100	Wld, Flg, Thd	Type 316L SS	--	--	

Notes:

1. Refer to Section 15006 – Ductile Iron Pipe. Buried RAS piping shall be mechanical joint at connections while RAS piping internal to the pump station shall be flanged.

1.04 VALVE SCHEDULES

- A. Performance Affidavits shall be required for all valves listed in the valve schedule(s). Performance Affidavits shall be provided in accordance with the Sections entitled "Equipment General Provisions" and "Submittals." All valves shall be tagged by the manufacturer according to the control valve designations listed in the Schedule, below.
- B. Valves not listed in the valve schedule(s) shall be manually operated, unless otherwise shown on the Drawings.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

Electric Valve Operator Schedule ¹

Tag Number ²	Valve / Actuator Status	Existing Valve Make / Model ³	Location	Function	Valve Type	Size (Inches)	Operator Type	I/P Action	Max D_p (psi)	Remote Manual Control Station ⁴
MOV 64012	New valve and actuator	---	RAS PS No. 1 suction manifold between Pumps 2 & 3	Flow Control	Plug Valve	16	¼ turn	Modulating	10	Install Remote Manual Control Station
MOV 64010	New valve and actuator	---	RAS PS No. 1 suction manifold between Pumps 1 & 2	Flow Control	Plug Valve	16	¼ turn	Modulating	10	Install Remote Manual Control Station
MOV 64013	Existing valve / Retrofit actuator	Val-Matic Flanged Cam- Centric® 100% Port Plug Valve w/ Bi-Directional Worm Gear; Model 5616F/5J12XP	RAS PS No. 2 suction manifold between Pumps 4 & 5	Flow Control	Plug Valve	16	¼ turn	Modulating	10	Install Remote Manual Control Station
MOV 64015	Existing valve / Retrofit actuator	Val-Matic Flanged Cam- Centric® 100% Port Plug Valve w/ Bi-Directional Worm Gear; Model 5616F/5J12XP	RAS PS No. 2 suction manifold between Pumps 5 & 6	Flow Control	Plug Valve	16	¼ turn	Modulating	10	Install Remote Manual Control Station
MOV 23010	Existing valve / Retrofit actuator	Dezurik Eccentric Valve, Cast-Iron, Resilient Faced Plug, with Limitorque H5BC Gear Actuator	RAS PS No. 3 suction manifold	Flow Control	Plug Valve	30	¼ turn	Modulating	15	Install Remote Manual Control Station
MOV 24010	Existing valve / Retrofit actuator	PRATT Valve A126 CL.B, FIG 601 30, 49100 CHLZ	RAS PS No. 4 suction manifold	Flow Control	Plug Valve	30	¼ turn	Modulating	15	Install Remote Manual Control Station

Electric Valve Operator Schedule ¹										
Tag Number ²	Valve / Actuator Status	Existing Valve Make / Model ³	Location	Function	Valve Type	Size (Inches)	Operator Type	I/P Action	Max D _p (psi)	Remote Manual Control Station ⁴
MOV 24424	Existing valve / Retrofit actuator	DeZurik Eccentric Valve, Cast-Iron, Resilient Faced Plug, with Actuator ABG16H16	RAS PS No. 3 Distribution Piping – Oxygenation Train 1	Flow Control	Plug Valve	18	¼ turn	Modulating	35	---
MOV 24414	Existing valve / Retrofit actuator	DeZurik Eccentric Valve, Cast-Iron, Resilient Faced Plug, with Actuator ABG16H16	RAS PS No. 3 Distribution Piping – Oxygenation Train 2	Flow Control	Plug Valve	18	¼ turn	Modulating	35	---

Notes:

1. Solenoid valves and pinch valves are not included in this table.
2. CONTRACTOR shall confirm/coordinate motor operated valve tag numbers with CITY.
3. Existing valve data is based on best available record information and shall be field confirmed.
4. Provide Remote Manual Control Station for electric actuator. Refer to Contract Drawings.

- END OF SECTION -

SECTION 15995 - PIPELINE TESTING

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. The CONTRACTOR shall perform flushing and testing of all pipelines and appurtenant piping, complete, including conveyance of test water from CITY-designated source to point of use and all disposal thereof, all in accordance with the requirements of the Contract Documents.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Commercial Standards

ANSI / AWWA B300	Hypochlorites
ANSI / AWWA B301	Liquid Chlorine
ANSI / AWWA C651	Disinfecting Water Mains

1.03 SUBMITTALS

- A. A testing schedule, including proposed plans for water conveyance, control, and disposal shall be submitted in writing for approval a minimum of seven (7) days before testing is to start.
- B. The CONTRACTOR shall submit hydrostatic test reports in accordance with Sections entitled "Submittals" and "Project Closeout".

PART 2 – PRODUCTS

2.01 MATERIALS REQUIREMENTS

- A. All test equipment, temporary valves or bulkheads, temporary vents or drains, or other water control equipment and materials shall be determined and furnished by the CONTRACTOR subject to the CITY'S review. No materials shall be used which would be injurious to the construction or its future function.

PART 3 – EXECUTION

3.01 GENERAL

- A. Notify the ENGINEER and CITY 48 hours in advance to obtain CITY'S approval to commence testing and/or disinfection of any particular structure and/or pipeline.
- B. Unless otherwise provided herein, water for flushing and testing pipelines will be furnished by the CITY; however, the CONTRACTOR shall make all necessary provisions for conveying the water from the CITY-designated source to the points of use.

- C. All pressure and gravity pipelines shall be tested. All testing operations shall be performed in the presence of the CITY.

3.02 FLUSHING

- A. 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 CITY. Liquid conveying pipelines shall be flushed at the rate of at least 2.5 feet per second for a duration suitable to the CITY or shall be flushed by other methods approved by the CITY.

3.03 HYDROSTATIC TESTING OF PIPING

- A. Following pipeline flushing, the CONTRACTOR shall hydrostatically test all pipelines either in sections or as a unit. No section of the pipeline shall be tested until all field-placed concrete or mortar have attained an age of 14 days. The test shall be made by closing valves when available, or by placing temporary bulkheads in the pipe and filling the line slowly with water. The CONTRACTOR shall be responsible for ascertaining that all test bulkheads are suitably restrained to resist the thrust of the test pressure without damage to, or movement of, the adjacent pipe. Care shall be taken to see that all air vents are open during filling.
- B. The pipeline shall be filled at a rate which will not cause any surges or exceed the rate at which the air can be released through the air valves at a reasonable velocity and all the air within the pipeline shall be properly purged. After the pipeline or section thereof has been filled, it shall be allowed to stand under a slight pressure for at least 24 hours to allow the concrete or mortar lining, as applicable, to absorb what water it will and to allow the escape of air from any air pockets. During this period, bulkheads, valves, and connections shall be examined for leaks. If leaks are found, corrective measures satisfactory to the CITY shall be taken.
- C. The test pressure for the hydrostatic test shall be as specified in Section 15390 – Pipe Schedule.
- D. The hydrostatic test shall consist of holding the test pressure on the pipeline for a period of 4 hours. All visible leaks shall be repaired in a manner acceptable to the CITY.
- E. The maximum allowable leakage shall be determined by the following formula:

$$L = \frac{SD\sqrt{P}}{148,000}$$

where D = Pipe diameter in inches
S = Length of lines in lineal feet
P = Average test pressure
L = Allowable leakage for system in gallons per hour

In the case of pipelines that fail to pass the prescribed leakage test, the CONTRACTOR shall determine the cause of the leakage, shall take corrective measures necessary to repair the leaks, and shall again test the pipelines. The CONTRACTOR shall provide all

reaction blocking and necessary plugs and caps required to test all piping installed as part of this Contract.

- F. The CONTRACTOR shall submit to the CITY a detailed description of the testing procedures to be utilized.

-END OF SECTION-

DIVISION 16 – ELECTRICAL

SECTION 16000 - 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. Where the word "CONTRACTOR" appears in these Technical Specifications it shall be construed to mean the Electrical contractor.
- C. The contractor shall reference the functional descriptions and other requirements found in Division 17, control and information systems, for additional requirements pertaining to work under this contract. The functional descriptions referenced herein shall be considered as part of the work required under this contract.
- D. The contractor shall be responsible for all interconnecting devices, conduit, wire, and appurtenances not furnished by others but required for the operation of equipment as described in the functional descriptions whether specifically shown on the drawings or not.
- E. The scope of work for this project primarily includes, but is not limited to, the following:
 - 1. Demolition of some RAS Pump Station No. 1 electrical distribution equipment including MCC-1C and RAS pumps 1,2,and 3.
 - 2. Demolition of associated wiring and conduits including unused conduits and wiring.
 - 3. Modifications to MCC-1CA.
 - 4. Extend and reconnect existing MCC-1CA loop tie feeder.
 - 5. Furnish and install new variable frequency drives for RAS Pumps Nos. 1, 2, and 3.
 - 6. Furnish and install new RAS pump motor feeders and control/instrumentation wiring.
 - 7. Furnish and install new motor disconnect switches for RAS Pumps Nos. 1, 2, and 3.
 - 8. Furnish and install new feeders to re-connect loads transferred from MCC-1C.

9. Installation of all underground raceway systems including conduit, fittings, manholes, pull boxes, hand holes and other pertinent components.
 10. Furnish and install all wire and cable resulting in a complete and operable electrical system.
 11. Furnish and install power and control conduits and wiring for 8 new motor operated valve actuators. Locations and details shown on drawings.
 12. Furnish and install new 480V, 3-ph panelboard in RAS PS-1 and RAS PS-2.
 13. Other electrical work as specified herein and indicated on the Drawings.
- F. 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.
- G. All electrical equipment shall conform to the applicable NEMA specifications. All electrical equipment shall be properly identified in accordance with these Specifications and Contract Drawings. All panelboards, starters, control panels, cabinet enclosures, junction boxes, pull boxes, and equipment switches shall be identified per the requirements of Section 16195 – Electrical Identification.
- H. All materials, equipment, sizes and capacities of electrical equipment incorporated in the project shall conform to the latest requirements of the current National Electric Code, the National Electrical Manufacturer's Association, the State and local electrical codes, and to other local authorities having jurisdiction (AHJs).
- I. All material and equipment must be the product of an established and reputable manufacturer; must be new and of first class construction; must be designed and guaranteed to perform the service required; and must bear the label of approval of the Underwriters Laboratories, Inc., or other nationally recognized testing laboratory that is accepted by the NEC where such approval is available for the product of the listed manufacturer as approved by the ENGINEER.
- J. 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 CITY.
- K. 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.
- L. Furnish and install controls for each piece of equipment requiring the controls under this Contract. The controls shall be the size and type recommended by the manufacturer for the application and as otherwise specified or indicated on the Drawings. Refer to Divisions 1 and 17 of the Specifications for control, connection and coordination descriptions and requirements.

- M. 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.

1.02 DRAWINGS

- A. The CONTRACTOR shall furnish, install, and place in satisfactory condition ready for operation, all conduits, cables, and all other material needed for the complete lighting, power, control and other electrical systems shown or indicated in the Contract Drawings. Additional conduits and the required wiring shall be installed by the CONTRACTOR wherever needed to complete the installation of the specific equipment furnished.

1.03 EQUIPMENT LOCATION

- A. The Drawings show the general location of feeders, transformers, outlets, 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 all of his work and shall arrange such work accordingly; furnishing 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 insure that proposed equipment will fit properly in spaces indicated.

1.04 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. All costs, both temporary and permanent to connect all utilities, shall be included in the Bid. Costs for connecting the electrical service include, but are not limited to, meter base, CT cabinet, and underground conduits. Coordination with the serving utility is required prior to the Bid to ensure these items have been adequately accounted for in the Bid. The CONTRACTOR shall be responsible for scheduling and coordinating with the local utility for temporary and permanent services.
- B. The CONTRACTOR shall be responsible for coordinating all electric utility equipment installations with the serving electric utility. The CONTRACTOR shall furnish and install all electric utility equipment required by the electric utility to be installed by the CONTRACTOR whether specifically shown on the Drawings or not. The CONTRACTOR shall furnish and install the following electrical utility equipment as a minimum:
 - 1. Concrete transformer pads constructed as instructed by the electric utility.
 - 2. Primary and secondary underground raceway systems as shown on the Drawings.
 - 3. Metering equipment cabinets and/or bases

4. Conduit and wire required from metering cabinet to metering current transformers and potential transformers.
 5. Secondary conductors
 6. Secondary terminations
- C. The electric utility will furnish and install the following equipment:
1. Primary underground raceway systems as shown on the Drawings.
 2. Primary conductors and terminations
- D. The CONTRACTOR is responsible for ensuring all electric utility equipment and construction installed by the CONTRACTOR is furnished and installed in accordance with the electric utility's design specifications and requirements. The CONTRACTOR is fully responsible for coordinating his scope of work with the electric utility. Any additional required electric utility construction or equipment not specified herein or shown on the Drawings shall be supplied by the CONTRACTOR at no additional cost to the CITY.
- D. 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 at no additional cost to the CITY.
- E. The CONTRACTOR shall be responsible for coordinating all construction related issues with the local electric utility. This includes, but not limited to utility data required for the power system studies specified herein.
- 1.05 SUBMITTALS
- A. In accordance with the procedures and requirements set forth in the General Conditions, Section 01300, Submittals 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. Spare Parts List
 4. Special Tools List
 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 no information.

1.06 APPLICABLE CODES AND REQUIREMENTS

A. Conformance

1. All work, equipment and materials furnished shall conform with the existing rules, requirements and specifications of the Insurance Rating Organization having jurisdiction, the serving electrical utility company, the latest edition of the National Electrical Code (NEC), the National Electric Manufacturers Association (NEMA), the Institute of Electrical and Electronic Engineers (IEEE), the Insulated Cable Engineers Association (ICEA), the American Society of Testing Materials (ASTM), the American National Standards Institute (ANSI), the requirements of the Occupational Safety Hazards Act (OSHA), and all other applicable Federal, State and local laws and/or ordinances.
2. All material and equipment shall bear the inspection labels of Underwriters Laboratories, Inc., if the material and equipment is of the class inspected by said laboratories. All existing electrical equipment that is modified in this project shall be field inspected and relabeled by Underwriters Laboratories, Inc. or other nationally recognized testing laboratory that is accepted by the NEC.
3. All work shall be in accordance with local codes.

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. Upon completion of the work, the CONTRACTOR shall obtain certificate(s) of inspection and approval from the National Board of Fire Underwriters or similar inspection organization having jurisdiction, the City of Hollywood Fire Marshall or the City of Hollywood Building Department. These certificate(s) shall be delivered to the ENGINEER and the CITY.

1.07 PERMITS AND INSPECTIONS

- A. The CONTRACTOR shall reference the General Conditions and Section 01010, Summary of Work.

1.08 TEMPORARY LIGHTING AND POWER

- A. The CONTRACTOR shall reference the General Conditions and Section 01510, Temporary Utilities.

1.09 TESTS

- A. Upon completion of the installation, the CONTRACTOR and/or a third party testing agency shall perform acceptance testing of equipment, as indicated herein. Tests shall be made with and to the satisfaction of the CITY and the ENGINEER. All tests shall be made in accordance with the recommendations of the NETA Acceptance Testing Specifications for Electric Power Distribution Equipment and Systems. All tests, including those listed as optional, shall be performed on each piece of equipment.
- 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 CITY. 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. The grounding system shall be tested to assure continuity and compliance with the contract requirements. Reference Section 16170, Grounding and Bonding, for specific testing requirements.
- D. Insulation resistance testing of all incoming and outgoing cables for switchgear, motor control centers, lighting and power distribution panelboards, and similar equipment shall be done after the cables are in place and just prior to final terminations. All data shall be recorded, as per Exhibit "A", attached to the end of this Section. See Section 16123 for detailed requirements.
- E. Feeder circuits shall be tested with the feeder conductors disconnected from the supplied equipment. Each individual power circuit shall be tested at the panel or motor control center with the power equipment connected for proper operation.
- F. The equipment to be tested shall include, but not be limited to, the following:
 - Dry Type Distribution Transformers
 - Panelboards
 - Individual Motor Controllers
 - Motor Control Centers
 - Lighting Systems
 - Variable Frequency Drives and Related Motor Control Equipment
 - Conduit System

- Cable and Wire
- Grounding System

- G. Refer to each specific specification section for detailed field tests.
- H. The CONTRACTOR shall complete the installation and testing of the electrical installation at least one (1) week prior to the start-up and testing of the respective equipment being served. 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.
- I. Before each test commences, the CONTRACTOR shall submit a detailed test procedure, and also provide test ENGINEER resume, manpower and scheduling information for the approval by the CITY and the ENGINEER. In addition, the CONTRACTOR shall furnish detailed test procedures for any of his equipment required as part of the field tests of other systems.
- J. Just prior to the final acceptance of a piece of equipment, an infrared inspection shall be performed to locate and correct all heating problems associated with that electrical equipment. The infrared inspection shall apply to all new equipment and existing equipment that is in any way modified under this Contract. All heating problems detected with new and modified equipment shall be corrected by the CONTRACTOR. Any problems detected with portions of existing equipment that were not modified under this Contract are not the responsibility of the CONTRACTOR; however, these problems shall be reported to the CITY and ENGINEER immediately. The infrared inspection shall include both digital and IR pictures which shall be submitted to the CITY for record purposes.

1.10 DOCUMENTATION

- A. The work requirements of this Section are in addition to and do not supersede testing and adjusting specified in other portions of the Contract Documents. The CONTRACTOR shall submit to the ENGINEER test records and reports for all testing.

1.11 PROTECTIVE DEVICE SETTING AND TESTING

- A. The CONTRACTOR shall provide the services of a qualified, independent, third party testing company using N.E.T.A. certified technicians to adjust, set, calibrate and test all protective devices in the electrical system. The company shall not be a subsidiary of the electrical equipment manufacturer. The qualifications of the testing company and resumes of the technicians as well as all data forms to be used for the field testing shall be submitted.
- B. All protective devices in the electrical equipment shall be set, adjusted, calibrated and tested in accordance with the manufacturers' recommendations, the coordination study, and best industry practice.
- C. Proper operation of all equipment associated with the device under test and its compartment shall be verified, as well as complete resistance, continuity and polarity tests of power, protective and metering circuits. Any minor adjustments, repairs and/or lubrication necessary to achieve proper operation shall be considered part of this Contract.

- D. All solid state trip devices shall be checked and tested for setting and operation using manufacturers recommended test devices and procedures.
- E. Circuit breakers and/or contactors associated with the above devices shall be tested for trip and close functions with their protective device.
- F. When completed, the CONTRACTOR shall provide a comprehensive report for all equipment tested indicating condition, readings, faults and/or deficiencies in same. Inoperative or defective equipment shall be brought immediately to the attention of the ENGINEER.
- G. Prior to placing any equipment in service, correct operation of all protective devices associated with this equipment shall be demonstrated by field testing under simulated load conditions.

1.12 SCHEDULES AND PLANT OPERATIONS

- A. Since the testing required in Article 1.11 above shall require that certain pieces of equipment be taken out of service, all testing procedures and schedules must be submitted to the ENGINEER for review and approval one (1) month prior to any work beginning. When testing has been scheduled, the ENGINEER must 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 plant equipment must be coordinated with the CITY/ENGINEER so as not to affect proper plant operations.
- B. At the end of the workday, all equipment shall be back in place and ready for immediate use should a plant emergency arise. In addition, should an emergency condition occur during testing, at the request of the CITY, the equipment shall be placed back in service immediately and turned over to plant personnel.
- C. In the event of accidental shutdown of plant equipment, the CONTRACTOR shall notify plant personnel immediately to allow for an orderly restart of affected equipment.

1.13 MATERIALS HANDLING

- A. Materials arriving on the job site shall be stored in such a manner as to keep material free of rust and dirt and so as to keep material properly aligned and true to shape. Rusty, dirty, or misaligned material shall 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. The CONTRACTOR shall store equipment and materials in accordance with Section 01550, Site Access and Storage.

(EXHIBIT A) TEST DATA - MEGOHMS TEST NO. ____							
Date:			Company:				
Time:			Location:				
Circuit:	Circuit Length:	Aerial:	Duct:	Buried:	No. of Conductors	Size:	AMG MCM Shld:
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 Made: _____
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
<input type="checkbox"/> Minute				5 Minutes			
<input type="checkbox"/> Minute				6 Minutes			
3/4 Minute				7 Minutes			
1 Minute				8 Minutes			
2 Minutes				9 Minutes			
3 Minutes				10 Minutes			
4 Minutes				10/1 Minutes			
				Ratio			

Remarks:

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. International Electrotechnical Commission (IEC) standards are not recognized. Equipment designed, manufactured, and labeled in compliance with IEC standards is not acceptable.
- 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, or devices that are provided under this Contract meet the requirements of Underwriters Laboratories, Inc., in regard to fire and casualty hazards. The label of or listing by the Underwriters Laboratories, Inc., will be accepted as conforming with this requirement.

2.02 SUBSTITUTIONS

- A. 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.

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 3 of the Specifications.
- B. The CONTRACTOR shall provide concrete equipment pads for all free standing electrical apparatus and equipment located on floors or slabs that exist or provided by others. 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 standard detail for equipment pads shown on the Contract Drawings.
- 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 or provided by others. 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 -- EXECUTION

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 his 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 his own expense.

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 2.

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 -

SECTION 16040 - ELECTRIC MOTORS

PART 1 -- GENERAL

1.01 SCOPE OF WORK

- A. This section specifies the quality criteria, design standards, materials, and installation procedures not otherwise specified, required for electrical motors furnished under other sections of these Contract Documents.

1.02 CONTRACTOR'S RESPONSIBILITIES

- A. Furnish and submit Shop Drawings, operation and maintenance manuals, etc. as outlined in Division 1, Section 01300 - Submittals. In addition, the submission shall include the following technical information:
 - 1. Motor Efficiency
 - 2. Motor Torque Speed Curves from Zero to Full Load Speed
 - 3. Nameplate Data According to NEMA MG1
 - 4. Additional Rating Information
 - a. Service Factor
 - b. Locked Rotor Current
 - c. No Load Current
 - d. Motor Rating (e.g. inverter duty)
 - 5. Conduit Box Dimensions and Usable Volume as Defined by NEMA MG1 and NFPA70
 - 6. Bearing Type, Lubrication, Life
 - 7. Space Heater Voltage and Watts
 - 8. Description and Rating of Motor Thermal Protection
 - 9. Motor Sound Power Level in Accordance with NEMA MG1
 - 10. Factory Test Reports, Certified
- B. The above information shall be supplied as part of the respective motor driven equipment submittal packages. Refer to Section 01300 – Submittals for additional requirements.

1.03 STANDARDS

- A. Electric motors shall be designed and manufactured to operate under the following conditions except for specific variations stated in other sections of these Specifications.

1.04 MANUFACTURER

- A. Electric motors shall be manufactured by General Electric, U.S. Motor, Siemens-Allis, or equal.
- B. For multiples of the same type and manufacture of a motor driven equipment item, furnish identical motors and accessories of the same manufacturer.
- C. In order to obtain single source responsibility, utilize a single supplier to provide a drive motor, its driven equipment, and specific motor accessories.

1.05 CONDITIONS OF SERVICE

- A. Continuous Duty
- B. Altitude below 3300 Feet
- C. Ambient Temperatures 0 to 40 degrees C Maximum
- D. Voltage Variation ± 10 percent (Unless Variable Speed)
- E. Frequency Variation Plus or ± 5 percent (Unless Variable Speed)
- F. Combined Voltage and Frequency Variation $\pm 10\%$, Frequency Variation Not To Exceed ± 5 percent (Unless Variable Speed)
- G. Across-the-Line Starting
- H. Pump Motors controlled by variable frequency drives and shall be inverter duty rated

1.06 TESTING

- A. Each motor shall be shop tested to determine compliance with requirements of the IEEE, ANSI and NEMA. Tests shall be as follows:
 - 1. Motors less than 30 hp: Each motor shall be subjected to a standard short commercial test including the following:
 - a. Running Light Current
 - b. Locked Rotor Current
 - c. High Potential
 - d. Winding Resistance
 - e. Bearing Inspection

2. Motors between 30 and 100 hp: Each motor shall be individually tested for efficiency.
 3. Motors larger than 100 hp: 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 light current, locked rotor current, breakdown torque (calculated), starting torque, winding resistance, high potential, efficiencies at 100, 75 and 50 percent of full load, power factors at 100, 75 and 50 percent of full load, and bearing inspection. The ENGINEER reserves the right to witness these tests.
- B. Test Reports: Copies of all test results shall be submitted to the ENGINEER for review. The number of copies of the tests shall be the same as the number of shop drawings to be submitted as specified in Division 1, Section 01300 - Submittals. Single copies of witnessed test raw data shall be submitted to the ENGINEER immediately upon completion of such tests.

PART 2 -- PRODUCTS

2.01 GENERAL

- A. Motors covered in this section shall be full voltage start, squirrel cage induction motor, constant speed, two-speed, or driven by variable frequency drive controllers, or specifically stated to be otherwise. The driven equipment manufacturer shall be responsible for supplying the motor and shall factory mount the motor to ensure proper coordination.

2.02 DESIGN OF MOTORS

A. Horsepower

1. The driven equipment manufacturer shall be responsible for sizing the motors in coordination with the driven equipment so that the nameplate rated horsepower are not exceeded and motors are not required to operate with their service factor at any point within the driven equipment operating range. For variable speed application, the motor shall be designed for operation at the rated maximum speed and at reduced speeds down to 50% without overheating. The ENGINEER reserves the right to reject driven equipment which requires motors larger than the limits specified in other sections of these specifications or to require the CONTRACTOR to bear all additional costs if larger electrical equipment is required.
2. Motors shall be furnished with NEMA and industry standard nameplate horsepower ratings.

- B. Temperature Rise: Motors shall conform to standards of NEMA Class F Tropicalized Insulation System and shall be limited to Class B temperature rise unless otherwise listed in the other parts of these specifications.

- C. Voltage and Current: Fractional horsepower motors (less than ½ hp) shall be 115/230V, 60 Hz single phase. Motors ½ hp through 400 hp shall be 460 V, 60 Hz, 3-phase. Motors larger than 400 hp shall be 4160V, 60 Hz, 3-phase.

- D. Service Factor: Unless otherwise specified, service factor shall be a minimum of 1.15.
- E. Speed: As specified with equipment.
- F. Torque: At least 20 percent greater than the maximum full load torque requirements or breakaway torque requirements, which ever is greater of the driven equipment throughout the full operating range of the driven equipment from start to full load.
- G. Speed Control
 - 1. Speed variation of squirrel cage motors will be accomplished by PWM (pulse width modulation) design variable frequency drives (except two-speed motors).
 - 2. Two-speed motors will be controlled by a two speed motor starter.
- H. Efficiency
 - 1. Motors in the range of 1 hp to 200 hp, inclusive, shall be designed specifically for energy efficiency and high power factor. In accordance with NEMA Standard MG 1-12.53b, each motor shall meet the minimum guaranteed efficiency for the specified nameplate efficiency. All motor efficiency tests shall be performed utilizing the NEMA preferred test method IEEE 112 method B, Dynamometer. All tests shall be performed in accordance with the procedures contained in NEMA Standard MG 1-12.53.
 - 2. Motors larger than 200 hp shall have a minimum efficiency, at full load, of 94 percent.
- I. Rating: All motors used with variable speed drives shall be inverter duty rated and shall have insulated bearings.

2.03 MATERIALS AND CONSTRUCTION

- A. Enclosure: The enclosure shall be the type as specified in respective parts of equipment specifications and shall be constructed of cast iron or fabricated steel of such design as to contain and adequately protect and support all motor components in proper position. Fans may form part of the rotor and shall be of non-sparking material on totally enclosed motors. Enclosures for motors shall be TEFC, unless otherwise specified. Motors shall be explosion-proof design where installed in designated explosive hazard areas. Enclosures shall have stainless steel vent screens. Fractional horsepower motor enclosures shall be TENV.
- B. Insulation: Motors shall have inorganic, non-hygroscopic tropicalized insulation unless otherwise noted in other parts of these specifications. Insulation shall be Class F.
- C. Stator
 - 1. The stator shall be assembled from high grade electrical sheet steel laminations adequately secured together.
 - 2. The stator windings shall consist of materials such as polyester film, synthetic varnish or glass cloth. Windings shall be random or form wound, adequately

insulated and securely braced to resist failure due to electrical stress and vibrations.

3. Any junction in motor insulation, such as coil connections or between slot and end winding sections, shall have protection equivalent to that of the slot sections of coils. The entire winding of all motors when finished, shall be epoxy encapsulated, after subjecting to a process which removes all moisture and insures freedom of air pockets.
4. For 200 and larger horsepower outdoor motors, three phase leads shall be connected by the motor manufacturer to the surge protection equipment described further in these Specifications, in a separate junction box mounted on the side of the motor. At least 18 inch clearance shall be provided to the conduit entry point in the box for the installation. This box shall be located in accordance with conduit terminations indicated on the plans.
5. For 200 horsepower and larger motors (plus for other motors if required in other Sections of the Specifications), six (6) 100 ohm (at 20 degrees C) platinum resistance temperature detectors shall be provided embedded in the stator winding and wired to a separate gasketed terminal box mounted on the stator frame. Two (2) detectors per phase are required and shall be placed at locations determined to give close approximation of the hottest spot temperatures. RTD's shall be furnished by the pump supplier and installed by the motor supplier.
6. Resistance temperature devices shall have a stability of better than 2 percent of the maximum exposed temperature for at least one year of service or 0.25 degrees C, whichever is greater. Repeatability of the resistance temperature device shall be better than 0.025 percent of the maximum temperature of 0.05 degrees C, whichever is greater.
7. Provide winding tropical/fungus protection.

D. Rotor

1. The shaft shall be made of high grade machine steel or steel forging of size and design adequate to withstand the load stresses. The rotor shall be fabricated of high grade electrical sheet steel laminations adequately fastened together and to the shaft. Squirrel cage windings may be cast aluminum or copper alloy bar-type construction with brazed end rings.
2. Provide winding tropical/fungus protection.

E. Bearings

1. Bearings shall be ball or roller anti-friction type. Motors up to 1,000 horsepower shall be grease lubricated. Unless specified otherwise, the bearings shall have a B-10 life as follows:

Motor Hp	B-10 Life (Hrs)
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Less than 50	24,000
50 to 200	40,000
Greater than 200	100,000

2. For 200 horsepower and larger motors (plus for other motors if required in other Sections of the Specifications), two (2) 100 ohm, platinum, 3 wire resistance temperature devices and stainless steel thermowells with connection heads shall be provided, 1 per bearing, minimum. The leads shall be brought to a separate conduit box mounted on the motor frame. The RTD's shall be furnished by the pump supplier and installed by the motor supplier. Overall coordination of the complete pump station shall be the responsibility of the pump supplier.
 3. Resistance temperature devices shall have a stability of better than 0.2 percent of the maximum exposed temperature for at least one year of service or 0.25 degrees C, whichever is greater. Repeatability of the resistance temperature device shall be better than 0.025 percent of the maximum temperature of 0.05 degrees C, whichever is greater.
 4. For vertical motors, thrust bearings shall be Kingsbury type, ball or roller bearings as required for the design thrust load. Guide bearings shall be radial type ball bearing.
- F. Space Heaters: Motor space heaters: All motors 30 horsepower and larger except if otherwise noted, shall be furnished with 120 V AC space heaters. The rating of the space heaters shall be determined in accordance with the motor manufacturer's standard for particular frame size and type. Coordinate the power requirements of the space heater with the manufacturer of motor starters or adjustable frequency drive for sizing of the control transformer. Space heater wire leads shall be brought out in the conduit box on the motor and clearly identified.
- G. Surge Protection: For 200 horsepower and larger outdoor motors, one 3-phase surge capacitor of suitable capacity and three lightning arresters shall be provided and connected in the junction box previously described.
- H. Leads and Terminals: Leads shall be suitably marked and identified. Terminal housing locations, which are not shown on the Plans, shall be NEMA Assembly F-1.
- I. Grounding Means: Each motor shall have adequate means for attaching #4/0 AWG copper grounding conductor to the motor frame near the base. It shall be a mechanical clamp terminal connector located on the same side as the stator lead junction box.
- J. Direction of Rotation
1. Motors shall be designed and manufactured for operation in a direction as required for driven equipment.

2. The phase sequence at the specified rotation shall be marked permanently and plainly on the motor.
- K. Noise: All motors shall have an equivalent A-weighted sound level of 80 db A as determined in accordance with IEEE Standard No. 85 under full load and full speed conditions, unless otherwise specified.
- L. Drain Plugs: All motors shall have breather and drain plugs to allow proper drainage of moisture from inside.
- M. Nameplates: Each motor shall have a stainless steel nameplate including the following minimum amount of information:
1. Manufacturer's Type Designation
 2. Frame Number
 3. Output Horsepower Rating
 4. Duty (Time Rating)
 5. Rated Load Speed (RPM)
 6. Temperature Rise in Degrees Centigrade at Rated Load
 7. Stator Voltage Rating
 8. Rotor Open Circuit Voltage (Wound Rotor)
 9. Stator Full Load Amperes
 10. Rotor Full Load Amperes (Wound Rotor)
 11. Service Factor (Marked for Operation at 40°C Ambient)
 12. Frequency
 13. Number of Phases
 14. Inrush of Locked Rotor kVA
 15. Code Letter Designation
 16. Efficiency
 17. Bearing Type, Size, Lubricant
- N. Winding Thermal Protection: Thermostats.
1. Motors for constant speed and adjustable speed application under 200 horsepower.

2. Bi-metal disk or rod-type thermostats embedded stator windings (normally open contact).
3. Automatic reset contacts rated 120 VAC, 5 amps minimum, closing on excessive temperature.

PART 3 -- EXECUTION

3.01 INSTALLATION

- A. Motors shall be mounted in accordance with the motor manufacturer's plans and instructions. Field installation of the unit shall include final alignment.
- B. Installation shall also include furnishing necessary oil and grease for initial operation and making final adjustments to place the equipment in operable condition. The CONTRACTOR shall furnish all necessary oil and grease for initial operation of equipment furnished under this Contract.

3.02 FIELD TESTS

- A. The motors and their driven equipment shall be tested together after installation as described in the applicable Specification Sections. The CONTRACTOR shall verify the direction of the motor rotation and correct it if required.

3.03 PAINTING

- A. The motors shall have a chemical resistant protective coating for corrosion and fungus protection on all interior surfaces.
- B. Motors shall be shipped to the site with shop prime compatible with the field applied exterior finish coating. After installation and before being placed in final operation, the motors shall be painted in accordance with Section 09900 - Painting.

- END OF SECTION -

SECTION 16111 - CONDUIT

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. Under this Section, the CONTRACTOR shall furnish and install all conduits and conduit fittings to complete the installation of all electrically operated equipment as specified herein and as required.
- B. The Drawings indicate the general location of conduits both exposed and concealed; however, the CONTRACTOR shall install these conduits in such a manner to avoid all interferences.
- C. Reference Section 16000 - Basic Electrical Requirements, and Section 16195 - Electrical Identification.

1.02 TESTING

- A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 1. 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 1, and Section 16000, Basic Electrical Requirements.
 - b. All conduit installed underground 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 after installation of suitable pulling tape.

1.03 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01300, Submittals, 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 re-submittal.
- C. Shop drawings shall include but not be limited to:
 - 1. Product data sheets.
 - 2. Conduit identification methods and materials.

PART 2 -- PRODUCTS

2.01 MANUFACTURERS

- A. The material covered by this Specification 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 CONDUITS

- A. Rigid Metal Conduits:
 - 1. Rigid Aluminum Conduit
 - 2. PVC Coated Rigid Aluminum Conduit
 - 3. Rigid Galvanized Steel Conduit
 - 4. PVC Coated Rigid Steel Conduit
- B. Minimum size conduit shall be 3/4 inch. The CONTRACTOR, at his option, for ease of installation to accommodate saddle size, may increase the size of encased conduits to 2-inch. However, no combining of circuits/conductors will be permitted in these larger conduits.
- C. Reference PART 3 – EXECUTION of this specification for additional information regarding conduit type for each application.
- D. Liquid-Tight Flexible Metal Conduit
 - 1. Liquid-tight flexible conduit (LFMC) shall be aluminum, single strip, with a copper strip interwoven and suitable as a grounding means. LFMC shall have an extruded moisture and oil-proof PVC jacket. LFMC shall be Liguatite Type "ALT" as manufactured by Electri-Flex, Titan Type "AEF" as manufactured by Sealtite, Type "EFL" as manufactured by Anaconda, or equal.
 - 2. Aluminum or stainless-steel watertight connectors shall be used with liquid-tight flexible metal conduit on both ends. LFMC shall be used to connect all vibrating equipment installed outdoors, in wet or damp areas, and other applications as directed by the ENGINEER.
- E. Rigid Nonmetallic Conduit

1. Rigid nonmetallic conduit shall be Schedule 80 polyvinyl chloride (PVC), 90°C, UL rated and shall conform to NEMA TC-2. Fittings and conduit bodies shall conform to NEMA TC3.
2. Rigid non-metallic conduit shall be as manufactured by Carlon, Triangle Conduit and Cable, Cantex, Inc., or equal.

F. PVC Coated Metal Conduit

1. PVC coated galvanized rigid steel or aluminum conduit shall be furnished and installed as specified herein and indicated on the Drawings. The product shall be rigid metal conduit covered with a bonded 40 mil (minimum) thickness PVC jacket and coated inside with urethane. The conduit shall comply with NEMA RN-1 and shall be "Plasti-Bond Red" as manufactured by Robroy Industries, "OCAL-Blue" as manufactured by Ocal, Inc., Perma-Cote Supreme by Perma-Cote Industries, or equal.

G. Conduit Fittings

1. Fittings for rigid metal conduit, liquid-tight flexible metal conduit, rigid nonmetallic conduit, and PVC coated metallic conduit shall conform to UL 467 and UL 514 as applicable.
2. All components of the conduit system shall be of the same material of construction. Rigid aluminum conduit systems shall include fittings, couplings, connectors, and other components compatible with and approved for such systems. Coated conduit systems shall include factory coated fittings couplings, connectors, and other components compatible with and approved for coated conduit systems.
2. Fittings for aluminum conduit shall be aluminum.
3. Set screw or indenter type connectors shall not be used. Fittings for conduit installed in wet locations and underground shall provide a watertight joint. Fittings for rigid conduit shall be threaded.
4. Fittings or bushings shall be installed in easily accessible locations.
5. Where exposed conduits pass across structural expansion joints, approved weatherproof telescopic type expansion fittings shall be used. Fittings shall be OZ/GEDNEY Type AX, Crouse-Hinds Type XJG, or equal, watertight, and permit movement up to 4 inches. Each fitting shall be equipped with approved bonding jumpers around or through each fitting. Bonding jumpers shall be Appleton, Crouse-Hinds, OZ/Gedney, or equal.
Where embedded conduits pass through expansion joints, approved watertight, concrete-tight deflection/expansion fittings shall be used. Fittings shall compensate for movement of $\frac{3}{4}$ -inch from the normal in all directions. Fittings shall be OZ/GEDNEY Type DX, Crouse-Hinds Type XD, or equal.

Where conduits transition from concrete ductbanks to control panels, walls (interior or exterior) expansion couplings shall be furnished and installed. Expansion couplings shall be Crouse-Hinds XJG-SA with internal ground.

6. Conduit fittings ("condulets") shall be used on exposed conduit work for lighting and power outlets, convenience outlets, changes in direction of conduit runs and breaking around beams. "Condulets" shall be aluminum, as manufactured by Crouse-Hinds, OZ/Gedney, Appleton Company, or equal. Coated fittings and boxes shall be used with coated conduit in chemically aggressive areas or where indicated on the Drawings. Covers shall be of a design suitable for the purpose intended. In damp areas, the outside condulets shall be made watertight. Install all condulets with the covers accessible. Use proper tools to assemble conduit system to prevent injury to the plastic covering. No damage to the covering shall be permitted.
7. Conduit fittings shall be aluminum. Cast fittings shall be provided with heavy threaded hubs to fit the conduit required. Covers shall be of the same material as the fittings to which they are attached and shall be screwed on with rubber or neoprene gaskets between the covers and fittings. Cast fittings 1-1/2 inches and above shall be of the "mogul" type. Where cast fittings are used to house wiring devices such as receptacles and switches, they shall be of the "deep" type.
8. PVC coated fittings shall be used with PVC coated conduit. All conduit nipples, elbows, couplings, boxes, fittings, unions, expansion joints, connectors, bushing, and other components of the raceway system shall be factory coated to maintain the corrosion-resistant integrity of the conduit system. The coated conduit and its respective components shall all be provided by the same manufacturer. Coated conduit shall be used in all areas specified herein or indicated on the Drawings.

PART 3 -- EXECUTION

3.01 CONDUIT AND FITTINGS

- A. All references to RMC shall mean rigid galvanized steel conduit (RGS) or rigid aluminum conduit unless otherwise noted.
- B. All references to PVC coated RMC shall mean PVC coated rigid galvanized steel conduit (RGS) or PVC coated rigid aluminum conduit unless otherwise noted.
- C. Minimum conduit size shall be 3/4 inch.
- D. Unless specified otherwise herein, or indicated on the Drawings, all conduits shall be rigid aluminum above ground or PVC coated rigid aluminum below ground including up to 12 inches above ground. At 12 inches above ground, PVC coated rigid aluminum conduit can be extended to equipment or if in non-corrosive areas can be transitioned to rigid aluminum conduit unless otherwise noted.
- E. Instrumentation conduit shall be rigid galvanized steel above or PVC Coated rigid galvanized steel below ground including up to 12 inches above ground. At 12 inches above ground, PVC coated rigid galvanized steel conduit can be extended to equipment or if in non-corrosive areas can be transitioned to rigid galvanized steel conduit unless otherwise noted.

- F. Conduit home runs for some lighting circuits are not necessarily indicated on the Drawings; however, the circuit numbers are shown. Conduit shall be furnished and installed for these lighting circuits and shall be installed as required to suit field conditions, subject to review and acceptance by the ENGINEER.
- G. Conduit shall be installed concealed unless otherwise indicated or specified. Conduit may be run exposed on walls only where concealing is not practical, or at the direction of the ENGINEER.
- H. Where exposed, maintain a minimum distance of 6 inches from parallel runs of flues or water pipes. Conduit runs shall be installed in such locations as to avoid steam or hot water pipes. A minimum separation of 12 inches shall be maintained where conduit crosses or parallels hot water or steam pipes.
- I. A non-metallic raceway containing instrumentation cable (if specifically allowed herein) where installed exposed shall be installed to provide the following clearances:
 - 1. Raceway installed parallel to raceway conductors energized at 480 through 208 volts shall be 18 inches and 208/120 volts shall be 12 inches.
 - 2. Raceway installed at right angles to conductors energized at 480 volts or 120/208 volts shall be 6 inches.
- J. Where practical, raceways containing instrumentation cable shall cross raceway containing conductors of other systems at right angles.
- K. For floor mounted equipment, conduit may be run overhead and dropped down, where underfloor installation is not practical. Groups of conduits shall be uniformly spaced, where straight and at turns. Conduit shall be cut with a hacksaw or an approved conduit-cutting machine and reamed after threading to remove all burrs. Securely fasten conduit to outlets, junction and pull boxes to effect firm electrical contact. Join conduit with approved couplings. Conduits shall be freed from all obstructions.
- L. Empty conduit systems shall be furnished and installed as indicated on the Drawings and shall have pull lines installed. The polypropylene pull lines shall be 180-200 test minimum. Not less than 12 inches of slack shall be left at each end of the pull rope.
- M. Each piece of conduit installed shall be free from blisters or other defects. Each piece installed shall be cut square, taper reamed, and a coat of sealing compound applied to threads. Threads on conduits shall be painted with a conducting compound prior to making up in a fitting. Conduit connections shall be made with standard coupling and the ends of the conduit shall butt tightly into the couplings. Where standard couplings cannot be used, Erickson three-piece couplings shall be used. Where conduits are installed in concrete, concrete-tight three-piece couplings shall be used.
- N. Conduit threaded in the field shall be of standard sizes and lengths.
- O. All bends shall be made with standard factory conduit elbows or field bent elbows. Field bending of conduit shall be done using tools approved for the purpose. Heating of conduit to facilitate bending is prohibited. Field bends shall be not less than the same radius than a standard factory conduit elbow. Bends with kinks shall not be acceptable.

The equivalent number of 90° bends in a single conduit run are limited to the following:

- | | | |
|----|-------------------------------|---|
| 1. | Runs in excess of 300 feet: | 0 |
| 2. | Runs of 300 feet to 201 feet: | 1 |
| 3. | Runs of 200 feet to 101 feet: | 2 |
| 4. | Runs of 100 feet and less: | 3 |

All conduit for fiber optic cable shall have a minimum bending radius of 16 inches. Final bending radius shall be determined by the fiber optic cable manufacturer.

- P. Unless otherwise specified herein, indicated on the Drawings, or required by the NEC, conduit shall be supported every 8 feet and shall be installed parallel with or perpendicular to walls, structural members, or intersections of vertical planes and ceilings with right angle turns consisting of fittings or symmetrical bends. Conduits shall be supported within 1 foot of all changes in direction. Supports shall be approved pipe straps, wall brackets, hangers or ceiling trapeze. Pre-formed channels for interior dry areas shall be zinc chromated galvanized steel or aluminum. For outdoor service or indoor damp/wet process areas, the pre-formed channels shall be aluminum or Type 316 stainless steel. All fasteners, clamps, straps, and anchors shall be aluminum or Type 316 stainless steel. Perforated strap hangers shall not be used.
- Q. In no case shall conduit be supported or fastened to another pipe or installed to prevent the removal of other pipe for repairs. Fastenings shall be by expansion bolts on concrete; by machine screws, welded threaded studs, or spring-tension clamps on steel work. Explosive-drive equipment may be used to make connections where the use of this equipment complies with safety regulations. Wooden plugs inserted in masonry and the use of nails as fastening media are prohibited. Threaded C-clamps may be used on rigid steel conduit only. Conduits or pipe straps shall not be welded to steel.
- R. The load applied to fasteners shall not exceed 1/4 of the proof test load. Fasteners attached to concrete ceilings shall be vibration and shock resistant. Holes cut to a depth of more than 1-1/2 inches in reinforced concrete beams or to a depth of more than 3/4 inch in concrete joints shall not cut the main reinforcing bars. Holes not used shall be filled. Spring type fasteners may only be used to support lighting branch circuit conduits to structural steel members. Conduits shall be fastened to all sheet metal boxes and cabinets with two (2) locknuts where required by the National Electrical Code to ensure adequate bonding for grounding. Where insulated bushings are used, or where bushings cannot be secured firmly to the box or enclosure, a bonding jumper shall be installed to maintain suitable grounding continuity. Locknuts shall be the type with sharp edges for digging into the wall of metal enclosures. Bushings shall be installed on the ends of all conduits and shall be of the insulating type where required by the National Electrical Code.
- S. Conduit installed in concrete floor slabs or walls shall be located so as not to affect the designed structural strength of the slabs. Conduit shall be installed within the middle one-third of the concrete slab except where necessary to not disturb the reinforcement. The outside diameter of conduit shall not exceed one-third of the slab thickness, and conduits shall be spaced no closer than three (3) diameters except at cabinet locations. Curved

portions of bends shall not be visible above the finish slab. Where embedded conduits cross expansion joints, suitable watertight expansion fittings and bonding jumpers shall be provided. Conduit larger than 1-inch trade size shall be parallel with or at right angles to the main reinforcement. When at right angles to the reinforcement, the conduit shall be close to one of the supports of the slab. Conduits shall not be stacked more than two (2) diameters high in floor slabs.

- T. Unless specifically identified on the Drawings as "Direct Buried," all conduits in the earth, including conduits below slabs-on-grade, shall be concrete encased. Joints in conduit shall be staggered so as not to occur side by side.
- U. No more than three (3) 90 degree bends will be allowed in any one conduit run. Where more bends are necessary, a conduit or pull box shall be installed. All bends in 3/4-inch conduit shall be made with a conduit bender, and all larger sizes shall have machine bends. Joints in threaded conduit shall be made up watertight with the appropriate pipe thread sealant or compound applied to male threads only; and, all field joints shall be cut square, reamed smooth, and properly threaded to receive couplings. No running threads are permitted. All conduit ends at switch and outlet boxes shall be fitted with an approved locknut and bushing forming an approved tight bond with box when screwed up tightly in place.
- V. Conduits stubbed up through concrete floors for connections to freestanding equipment and for future equipment shall be provided with an adjustable top or coupling threaded inside for plugs, set flush with the finished floor. Screwdriver operated threaded flush plugs shall be installed in conduits from which no equipment connections are made.
- W. 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 whether placed correctly or incorrectly on the Drawings. Changes in outlet locations required to serve the equipment furnished by other Contractors on the Project shall be brought to the attention of the ENGINEER.
- X. Conduit shall be protected immediately after installation by installing flat non-corrosive metallic discs and steel bushings, designed for this purpose, at each end. Discs shall not be removed until it is necessary to clean the conduit and install the conductors. Before the conductors are installed, insulated bushings shall be installed at each end of the conduit.
- Y. Where "all-thread" nipples are used between fittings and electrical equipment, they shall be so installed that no threads are exposed.
- Z. Connections from rigid conduit to motors and other vibrating equipment, limit switches, solenoid valves, level controls, and similar equipment, shall be made with short lengths of liquid-tight flexible metal conduit. These conduits shall be installed in accordance with the NEC and shall be furnished and installed with appropriate connectors with devices which will provide an excellent electrical connection between the equipment and the rigid conduit for the flow of ground current. Liquid-tight flexible metal conduit length shall be three (3) feet, maximum.
- AA. Liquid-tight flexible metal conduit installed between rigid metal conduit and motor terminal box and/or any other apparatus shall have a green insulated grounding conductor running

through the flexible conduit. This conductor shall be terminated to the nearest pull box, motor terminal box, or any other apparatus ground terminal. Liquid-tight flexible metal conduit shall be grounded and bonded per NEC Articles 348 and 350, respectively.

- AB. All threaded ends of conduits shall be coated with an approved conducting compound as manufactured by Thomas & Betts, or equal prior to making up the joint.
- AC. Conduits installed within or underneath floor slabs, underground direct-buried or concrete encased conduits, and all conduits installed in areas subject to liquid inadvertently entering the conduit system shall be sealed or plugged at both ends in accordance with NEC Article 300-5(g). This requirement applies to both conduits containing conductors and "spare" conduits. Where practicable, the interior of the conduit shall be sealed as well as around the conductors by using conduit sealing bushings: Type CSB as manufactured by O/Z Gedney, or equal. Where the conduit fill does not allow the use of these bushings, the conduits shall be tightly caulked or plugged.
- AD. Conduit passing through the walls and floors of buildings below grade shall be installed with appropriate watertight fittings to prevent the entrance of ground water around the periphery of the conduits. For vertical conduit penetrations through openings in concrete floors, the fittings shall be Type FSK Floor Seals as manufactured by OZ/Gedney. For conduit penetrations through openings in concrete walls, the fittings shall be Type WSK Thruwall seals as manufactured by OZ Gedney. Conduits shall be sloped away from the buildings toward splice boxes, handholes and/or manholes to provide drainage away from the building wall.
- AE. Conduits passing through sleeves in interior walls and floors shall be tightly caulked.
- AF. Weatherproof, insulated throat "Meyers" hubs shall be used on all conduit entries to boxes and devices without integral hubs in process areas to maintain NEMA 4X integrity. The CONTRACTOR shall furnish and install "Meyers" hubs on all conduit entries into non-cast enclosures such as metallic or non-metallic control panels, control component enclosures, wireways, pull boxes, junction boxes, control stations, and similar type equipment when this type of equipment is located in process areas requiring NEMA 4X integrity. This specified requirement for "Meyers" hubs does not apply to any area of the plant facilities where NEMA 4X integrity is not required. Aluminum "Myers" hubs shall be furnished and installed where required as part of the aluminum conduit system.
- AG. The use of two locknuts, one on each side of the enclosure, and a grounding bushing shall be required at all conduit terminations where hub type fittings are not required; such as electrical rooms, control rooms, and office areas.
- AH. Conduit installation shall be arranged to minimize cleaning. No horizontal runs of conduit will be permitted in brick or masonry walls.
- AI. All PVC coated conduit shall be installed in accordance with manufacturer's instructions. The CONTRACTOR shall use tools that are specifically suited for coated conduit systems. The use of pipe wrenches and other such tools on PVC coated RGS conduit is prohibited. The ENGINEER and CITY reserve the right to reject any installation of coated conduit that does not meet the requirements of the Section or the manufacturer's instructions. The ENGINEER and CITY also reserve the right to reject any installation that exhibits damage due to the improper use of tools. All rejected installations shall be replaced by the

CONTRACTOR at no additional cost to the CITY. The use of PVC coated conduit repair compounds to repair damages or improper installation is prohibited.

- AJ. Conduits shall not penetrate the floors or walls inside liquid containment areas unless specifically accepted by the ENGINEER.
- AK. All conduits that are buried or encased in concrete that transition from the ground to any stationary structure or equipment shall be equipped with an expansion coupling capable of at least six inches of expansion.
- AL. Raceways shall not be installed concealed in water-bearing walls and floors.
- AM. Where flexible conduit is required in a Class 1, Division 1 Hazardous area, a type ECGJH braided flexible coupling shall be used, as manufactured by Crouse-Hinds. Braiding and ends shall be of stainless-steel construction. Couplings using un-coated copper braid are not acceptable.
- AN. The CONTRACTOR shall furnish and install conduit seals entering or leaving NEC Article 500 hazardous areas. The CONTRACTOR shall furnish and install conduit seals in other hazardous locations as required by the NEC.
- AO. The CONTRACTOR shall install conduit seals on conduit entering or leaving areas of buildings in which sodium hypochlorite is stored or distributed.
- AP. The CONTRACTOR shall install conduit seals in conduits transitioning between warmer rooms, areas or outdoors and cooler rooms to prevent condensation within the conduits.

3.02 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, condulets, 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: Centrifuge Feed Grinder 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: MCC-DEW). This requirement applies only to the source and load ends of the conduit, and not anywhere in between.
 - 3. For conduits ¾" through 1 ½" in size, the text shall be a minimum 18-point font. For conduits 2" and larger, the text shall be a minimum 24-point font.

4. Label height shall be $\frac{3}{4}$ " 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. Handwritten labels are not acceptable.
 6. Labels shall be made of permanent vinyl with adhesive backing as manufactured by Brady, Seton equivalent, Panduit equivalent, or equal. 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.
 3. Tags shall be White Tyvek as manufactured by Brady, Seton equivalent, Panduit equivalent, or equal.
- C. Conduits for lighting and receptacle circuits shall not require identification.
- D. Alternatives to this proposed conduit identification method shall be submitted to the ENGINEER as part of the shop drawing submittal.
- E. Any problems or conflicts with meeting the requirements above shall immediately be brought to the attention of the ENGINEER immediately for a decision.

- END OF SECTION

SECTION 16123 - BUILDING WIRE AND CABLE

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The CONTRACTOR shall furnish, install, connect, test, and place in satisfactory operating condition, ready for service, all cables and wires indicated on the Drawings and as specified herein or required for proper operation of the installation, with the exception of internal wiring provided by electrical equipment manufacturers. The work of connecting cables to equipment, machinery, and devices shall be considered a part of this Section. All hardware, junction boxes, bolts, clamps, insulators, and fittings required for the installation of cable and wire systems shall be furnished and installed by the CONTRACTOR.
- B. 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 years.
- C. Reference Section 16000, Basic Electrical Requirements.

1.02 TESTING

- A. All testing shall be performed in accordance with the requirements of the General Conditions and Division 1. The following tests are required:
 - 1. Witness Shop Tests
 - a. Not required.
 - 2. Shop Test
 - a. Cable and wiring 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.
 - 3. Field Tests
 - a. Field testing shall be done in accordance with the requirements specified in the General Conditions, Division 1, and NETA acceptance testing specifications referenced in Section 16000, Basic Electrical Requirements.
 - b. After installation, all wires and cables shall be tested for insulation levels and continuity. Insulation resistance between conductors of the same circuit and between conductor and ground shall be tested. Testing for insulation levels shall be as follows:
 - 1. For 600V power and control cable, apply 1,000 VDC from a Megaohmmeter for all 600V wires and cables installed in lighting, control, power, indication, alarm and motor feeder circuits. Testing for continuity shall be "test light" or "buzzer" style.

2. 600V 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 Megaohms or greater.
- B. Low voltage wires and cables shall be tested before being connected to motors, devices or terminal blocks.
- C. Voltage tests shall be made successively between each conductor of a circuit and all other conductors of the circuit grounded.
- 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 City.
- 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.

1.03 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01300, Submittals, the CONTRACTOR shall obtain from the wire and cable manufacturer and submit the following:
 1. Shop Drawings
 2. Reports of Certified Shop and Field Tests
 3. Wiring Identification Methods
- 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.
 2. Cable pulling calculations.
 3. Wiring identification methods and materials.

1.05 IDENTIFICATION

- A. Each cable shall be identified as specified in Part 3, Execution, of this Specification.

1.06 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 by Ideal, Cable Gel by Greenlee, Poly-Gel by Gardner Bender, or equal.

1.07 CABLE PULLING CALCULATIONS

- A. The CONTRACTOR shall submit cable pulling calculations. These calculations, to be performed by a currently registered professional ENGINEER in the State of Florida, shall define pulling tension and sidewall loading (sidewall bearing pressure values) for all installations of 600VAC, #1/0 conductors and larger greater than 200 feet in length. Calculations for straight horizontal installations of 600VAC, #1/0 conductors and larger greater than 200 feet are not required.

PART 2 -- PRODUCTS

2.01 MANUFACTURERS

- A. The wire and cable covered by this Specification is intended to be standard equipment of proven performance. 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. Only one (1) manufacturer for each wire and cable type shall be permitted.
- B. The wire and cable manufacturer shall be ISO 9000 registered.

2.02 600 VOLT POWER WIRE AND CABLE

- A. 600 volt building wire shall consist of stranded, copper conductor with insulation rated THHN, 90°C for dry locations and THWN, 75°C for wet or damp locations where the maximum voltage to ground does not exceed 208VAC.
- B. 600 volt conductors installed in wet or damp locations or operating at 480 volts shall have type XHHW insulation.
- C. Conductors shall be stranded copper per ASTM-B8 and B-33, and Class B or C stranding contingent on the size unless otherwise specified. Minimum size wire shall be No. 12 AWG.
- D. 600 volt individual power wire and cable shall be Okoseal-N as manufactured by the Okonite Company, Cerro Wire and Cable equivalent, Southwire Company equivalent (with SIMpull Jacket), or equal. Multi-conductor power cables shall be Okoseal-N Type TC Cable as manufactured by the Okonite Company, Cerro Wire and Cable equivalent, Southwire Company equivalent (with SIMpull Jacket), or equal.

2.03 600 VOLT CONTROL CABLE

- A. 600 volt control cable shall consist of stranded, copper conductor with insulation rated THHN, 90°C for dry locations and THWN, 75°C for wet or damp locations. The individual

conductors of the multiple conductor cable shall be color coded for proper identification. Color coding shall be equal to ICEA S-68-514, Method 1, E-2. Cables shall meet requirements of IEEE-383.

- B. Conductors shall be stranded copper per ASTM B-8 and B-33, and Class B or C stranding contingent on the size unless otherwise specified. Minimum wire size shall be No. 14 AWG.
- C. 600 volt individual conductor control wire shall be Okoseal-N as manufactured by the Okonite Company, Cerro Wire and Cable equivalent, Southwire Company equivalent (with SIMpull Jacket), or equal. Multi-conductor control cable shall be Okoseal-N Type TC Cable as manufactured by the Okonite Company, Cerro Wire and Cable equivalent, Southwire Company equivalent (with SIMpull Jacket), or equal.

2.04 LIGHTING AND RECEPTACLE WIRE AND CABLE

- A. The lighting and receptacle branch circuit wire shall consist of copper conductors with insulation rated THHN, 90°C for dry locations and THWN, 75°C for wet or damp locations.
- B. Minimum power wiring size wire shall be No. 12 AWG.
- C. Lighting and receptacle cables and wire shall be Okoseal-N as manufactured by the Okonite Company, Cerro Wire and Cable equivalent, Southwire Company equivalent (with SIMpull jacket), or equal.

2.05 INSTRUMENTATION CABLE

- A. The instrumentation cable for analog signals shall be single, shielded, twisted pairs or triads with 600 volt insulation and shall have a 90°C insulation rating.
- B. Conductors shall be tin or alloy coated (if available), soft, annealed copper, stranded per ASTM-B8, Class B stranding unless otherwise specified. Minimum size wire shall be No. 16 AWG.
- C. The instrumentation cable shall be Okoseal-N Type P-OS for single pair or triad applications and Okoseal-N Type SP-OS for multiple pair or triad applications as manufactured by the Okonite Company, Cerro Wire and Cable equivalent, Southwire Company equivalent (with SIMpull Jacket), or equal.

PART 3 -- EXECUTION

3.01 600V CABLE INSTALLATION

- A. The cable and wires shall be installed as specified herein and indicated on the Drawings.
- B. The cables shall be terminated in accordance with the cable and/or termination product manufacturer's instructions for the particular type of cable.
- C. To minimize oxidation and corrosion, wire and cable shall be terminated using an oxide-inhibiting joint compound recommended for "copper-to-copper" connections. The compound shall be Penetrox E as manufactured by Burndy Electrical, or equal.

D. Splices shall not be allowed in the underground manhole and handhole systems. If splices are required, the CONTRACTOR shall obtain approval in writing from the ENGINEER prior to splicing. Splicing materials shall be barrel type butt splice connectors and heat shrink tubing as manufactured by 3M, Ideal, or equal. No splicing of instrumentation cable is allowed. The use of screw-on wire connectors (wire nuts) for power or control wiring will only be permitted if specifically accepted by the ENGINEER. Reference Section 16130 for additional requirements regarding control wiring.

E. 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 at the load does not exceed 2-1/2%.
2. Minimum wire size within control panels, motor control centers, switchboards and similar equipment shall be No. 12 AWG for power and No. 14 AWG for control.

F. Number of Wires

1. The number of wires indicated on the Drawings for the various control, indication, and metering circuits were determined for general schemes of control and for particular indication and metering systems.
2. The actual number of wires installed for each circuit shall, in no case, be less than the number required; however, the CONTRACTOR shall add as many wires as may be required for control and indication of the actual equipment selected for installation at no additional cost to the City. The addition of conductors shall be coordinated with and approved by the ENGINEER to avoid violations of the NEC regarding conduit fill.
3. All spare conductors shall be terminated on the terminal blocks mounted within the equipment.

G. Wiring Identification

1. In addition to color coding, 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 City and ENGINEER to come to an agreement regarding a wire identification system prior to installation of any wiring. Wire numbers shall not be duplicated.
2. Wire identification shall be by means of a heat shrinkable sleeve. Sleeves shall have a white background with 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.
3. Sleeves shall be suitable for the size of wire on which they are installed. When

installation is complete, 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.

4. Sleeves shall be installed prior to the completion of the wiring terminations and shall be oriented so that they can be easily read.
5. Sleeves shall be white polyolefin as manufactured by Brady, Seton equivalent, Panduit equivalent, or equal.
6. Where sleeves are not available in the size required for the wire, the CONTRACTOR shall use a self-laminating polyester type label with a white background and black text with a clear overlay. Text size shall be in accordance with the requirements listed above.
7. Adhesive labels, for the case when sleeves are not suitable for the wire size, shall be white permanent vinyl as manufactured by Brady, Seton equivalent, Panduit equivalent, or equal.
8. Wire identification in manholes, handholes, pull boxes, and other accessible components in the raceway system where the wiring is continuous shall be accomplished by means of a tag installed around the bundled group of conductors. Identification shall utilize a FROM-TO system. Each group of conductors shall consist of all of 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 particular conduit number in the conduit and wire schedule. Minimum text size shall be 10 point. The tag shall be affixed to the wire bundle by the use of nylon wire ties, and shall be made of polyethylene as manufactured by Brady, Seton equivalent, Panduit equivalent, or equal.

H. Cable Installation

1. All interior cable not protected by a compartment enclosure shall be installed in conduit.

I. Wiring Supplies

1. Only electrical wiring supplies manufactured under high standards of production and meeting the approval of the ENGINEER shall be used.
2. Rubber insulating tape shall be in accordance with ASTM Des. D119. Friction tape shall be in accordance with ASTM Des. D69.

J. Training of Cable

1. The CONTRACTOR shall furnish all labor and material required to train cables around cable vaults within buildings and in manholes and handholes in the outdoor underground duct system. 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. Instrumentation cable shall be racked separate from all other AC and DC wiring to maintain the required separation specified herein. 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. Reference Section 16118.

K. Connections at Control Panels, Limit Switches, and Similar Devices

1. Where stranded wires are terminated at panels, and/or devices, connections shall be made by solderless lug, crimp type ferrule, or solder dipped.
2. Where enclosure sizes and sizes of terminals at limit switches, solenoid valves, float switches, pressure switches, temperature switches, and other devices make 7-strand, No. 12 AWG, wire terminations impractical, the CONTRACTOR shall terminate external circuits in an adjacent junction box of proper size complete with terminal strips and shall install No. 14 AWG stranded wires from the device to the junction box in a conduit. The #12 AWG field wiring shall also be terminated in the same junction box to complete the circuit.

L. Pulling Temperature

1. Cable shall not be flexed or pulled when the temperature of the jacket is such that damage will occur due to low temperature embrittlement. When cable will be 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 work day for which the cable is removed from the protected storage. Any remaining cable reels shall be returned to storage at the completion of the workday.

M. Color Coding

1. Conductor insulation shall be color coded as follows:
 - a. 480/277V AC Power
 - Phase A - BROWN
 - Phase B - ORANGE
 - Phase C - YELLOW
 - Neutral - GREY
 - b. 120/208V or 120/240V AC Power
 - Phase A - BLACK
 - Phase B - RED
 - Phase C - BLUE
 - Neutral - WHITE
 - c. DC Power
 - Positive Lead - RED

Negative Lead - BLACK

- d. DC Control

All wiring - BLUE

- e. 120VAC Control

Single conductor 120 VAC control wire shall be RED except for a wire entering a motor control center compartment or control panel which is an interlock. This conductor shall be color coded YELLOW.

- f. 24VAC Control

All wiring - ORANGE

- g. Equipment Grounding Conductor

All wiring - GREEN

- 2. Conductors No. 2 AWG and smaller shall be factory color coded with a separate color for each phase and neutral, which shall be used consistently throughout the system. Larger cables shall be coded by the use of colored tape in accordance with the requirements listed above.
- 3. Low voltage feeder and branch circuit conductors shall be identified in accordance with the NEC. The method utilized for conductor identification for each nominal voltage system shall be permanently posted at each feeder or branch circuit distribution equipment assembly. Reference Articles 200, 210, and 215 of the NEC.

3.02 INSTRUMENTATION CABLE INSTALLATION

- A. The CONTRACTOR shall install all cable or conductors used for instrumentation wiring (4-20 mA DC, etc.) in rigid steel or PVC coated rigid steel conduit. Analog signal wires shall exclusively occupy these conduits. No other wiring for AC or discrete DC circuits shall be installed in these conduits.
- B. All shielding shall be continuous and shall be grounded at one point only, or in accordance with the instrumentation equipment manufacturer's recommendations.
- C. Where instrumentation cables are installed in panels, manholes, handholes, and other locations, the CONTRACTOR shall arrange wiring to provide maximum clearance between these cables and other conductors. Instrumentation cables shall not be installed in same bundle with conductors of other circuits.
- D. Additional pullboxes shall be furnished and installed for ease of cable pulling and the cable manufacturer's recommended conduit fill factor shall be followed. Where required or specifically directed by the ENGINEER, the CONTRACTOR shall moisture seal the cables at all connections with OZ Gedney Type "CSB", or equal, sealing bushings.

- E. Special instrument cable shall be as specified or recommended by the manufacturer of the equipment or instruments requiring such wiring. Installation, storage, terminations, etc., shall be per manufacturer's recommendations.
- F. All cable insulation and jackets shall have adequate strength for it to be pulled through the conduit systems. All conductors shall be color coded and all wires shall be suitably tagged with permanent markers as specified herein.

3.03 FIBER OPTIC CABLE INSTALLATION

- A. The CONTRACTOR shall furnish and install the fiber optic cables unless the cables are furnished by the General CONTRACTOR and/or the Instrumentation and Control Subcontractor; in that case the CONTRACTOR shall install the fiber optic cables. The cable shall be installed in its respective raceway system(s) as specified herein, indicated on the Drawings, and in accordance with the cable manufacturer's instructions. Reference Division 17 for additional information regarding the fiber optic cable.

- END OF SECTION -

SECTION 16130 - BOXES

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 pull, junction and outlet boxes for power, lighting and control as required for a complete electrical installation as shown on the Drawings and specified herein.
- B. Coordination
 - 1. The CONTRACTOR shall review installation procedures under other Divisions and coordinate them with the Work specified herein.
 - 2. The CONTRACTOR shall notify others in advance of the installation of the Work included herein to provide them with sufficient time for the installation and coordination of interrelated items that are included in the Contract and that must be installed in conjunction with the Work included in this Division.
- C. Boxes shall conform to all applicable Federal, UL and NEMA standards. Materials and components shall be new and conform to grades, qualities and standards as specified herein and shown on the Drawings.
- D. Reference Section 16000, Basic Electrical Requirements.

1.02 TESTING

- A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 1. The following tests are required:
 - 1. Witnessed Shop Test
 - a. None required.
 - 2. Field Tests
 - a. None required.

1.03 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01300, Submittals, 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.
 - 2. Complete assembly, layout, and installation drawings for each box 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 PULL, JUNCTION, AND OUTLET BOXES

- A. Exposed Indoor Wet Process and Outdoor Areas
 - 1. Exposed outlet boxes for outdoor and indoor wet process areas used for lighting fixtures, switches, and receptacles shall be of cast, rust-resisting aluminum provided with rubber or neoprene gasketed covers of similar metal. Covers for outlet boxes shall be of the full time connection type (able to have a cord plugged in while cover is in closed position. Junction and pull boxes shall be of NEMA 4X TYPE 316 stainless steel construction and of ample size to house the required devices.
- B. Concealed
 - 1. Outlet boxes for concealed work shall be a minimum of 4 inches square and 2 inches deep consisting of zinc coated pressed steel provided with knockouts for the conduit required. Boxes shall be provided with approved covers or plastic rings where necessary.
 - 2. Boxes for housing receptacles, switches and similar devices shall be of the deep type.
- C. Exposed Indoor Dry Locations
 - 1. Pull and junction boxes for indoor exposed use in dry locations shall be aluminum with neoprene gasketed screwed-on covers and of all welded construction.

D. Exposed Chemical Storage and Transfer Areas

1. Outlet, junction, and pull boxes for exposed work in chemical storage and transfer areas shall be Schedule 80 PVC where Schedule 80 PVC is specified in Section 16111 and/or on the Drawings for the conduit in that area.
2. Outlet, junction, and pull boxes for exposed work in all other chemical storage and transfer areas shall be the same as required herein for wet process area.

E. Miscellaneous

1. The CONTRACTOR shall furnish and install enclosures for housing interfacing and transition equipment, or other equipment requiring an enclosure. The CONTRACTOR shall be responsible for mounting the enclosure. The enclosures shall be a low profile type, weatherproof and lockable. The enclosures shall be furnished and installed in complete compliance with the NEC and with all state and local codes. The single door aluminum enclosure shall be unpainted and shall be manufactured by Hoffman, Rittal, The Austin Company, or equal.
2. For outdoor and indoor wet process area use, aluminum or NEMA 4X type 316 stainless steel junction and pull boxes shall be provided. Boxes shall be equipped with neoprene gasketed covers which have been cross ribbed and checkered. Boxes shall be provided with continuous hinge doors with quick release (fast operating) clamp assemblies that do not require bolts or screws to secure or removable screw covers to suit the application. Stainless steel cover screws are required. Boxes shall match and be sized for the conduit(s) to which they are attached.
3. Aluminum boxes shall be fabricated in accordance with U.L. specifications from Code Gauge Type 5052 H-32 aluminum. Unpainted aluminum interior panels shall be provided as required.
4. All boxes shall be U.L. listed and labeled.
5. For boxes shown or required in hazardous locations, boxes shall be furnished and installed in accordance with the Class, Division, and Group suitable for the application.

F. Box Sizes

1. The minimum size of boxes shall be according to the NEC. No box shall be filled to more than 40% of capacity.

G. Barriers

1. Aluminum barriers shall be provided in junction or pull boxes to isolate conductors of different voltages and functions. Isolation shall be provided between the following groups:
 - a. Power (480 and 120 volts)

- b. Control wiring
 - c. Instrumentation wiring (twisted, shielded pairs or triads)
2. Barriers shall be provided in multi-gang outlet boxes when the voltage between switches exceeds 300 VAC.

PART 3 -- EXECUTION

3.01 INSTALLATION

A. Outlet Boxes

1. All outlet boxes required for supporting lighting fixtures shall be provided with fixture studs of sizes suitable for supporting the weight of the fixtures connected thereto. Fixture studs shall not be less than 3/8 inches in diameter and shall be either integral with the box or of the type which is inserted and supported from the back of the box. In no case will the support of a fixture be dependent upon bolts holding the stud to the box.
2. Outlet boxes for concealed work shall be arranged and located so that tile, where required, may be cut in straight lines to fit closely around the boxes, and so placed that the cover or device plate shall fit flush to the finished wall surface.
3. The exteriors of exposed outlet boxes shall be field painted, where required, in accordance with Section 09900, Painting.

B. Junction and Pull Boxes

1. All junction boxes and pull boxes shall be solidly attached to structural members prior to installation of conduit and set true and plumb. Wooden plugs are not permitted for securing boxes to concrete. Sidewalk-type boxes shall be cast into concrete structures and shall be flush with concrete services after installation.
2. Where control wires must be interconnected in a junction box, terminal strips, consisting of an adequate number of screw type terminals shall be installed. Current carrying parts of the terminal blocks shall be of ample capacity to carry the full load current of the circuits connected. Approximately 20 percent of the total amount of terminals provided shall consist of spare terminals. Terminals shall be lettered and/or numbered to conform with the wiring diagrams.
3. All junction boxes and pull boxes shall have identifying nameplates attached, which when installed on sidewalk type boxes shall not extend above the surrounding concrete slabs. All boxes shall be indicated and identified on the as-built drawings.

- END OF SECTION -

SECTION 16141 - WIRING DEVICES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The CONTRACTOR shall furnish and install all switches and receptacles for lighting and miscellaneous power applications of the type and at the locations as specified herein and as shown on the Drawings.
- B. All switches and receptacles shall be furnished and installed in outlet boxes as specified in Section 16130, Boxes.
- C. Reference Section 16000, Basic Electrical Requirements.

1.02 TESTING

- A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 1. The following tests are required:
 - 1. Witnessed Shop Tests
 - a. None required.
 - 2. Field Tests
 - a. None required.

1.03 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01300, Submittals, 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 SUPPLIES AND 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. Spare parts lists, included with the shop drawing submittal, 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. 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.

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. Wiring devices as listed herein are intended to indicate type, function, and quality of the products.
- E. The receptacles, switches, device plates, and other appurtenances shall comply with the requirements of these Specifications. Receptacles installed in toilet, locker, and bathrooms shall be of ground fault interrupter type to meet the minimum NEC requirements. Ground fault circuit interrupter receptacles shall also be furnished and installed as specified herein, indicated on the Drawings, and required by the NEC.
- F. Wiring devices shall be approved for use with stranded conductors.

- G. The CONTRACTOR shall provide specification grade devices which shall be as manufactured by Appleton, Crouse-Hinds, Leviton, Harvey Hubbell Co., General Electric Company, Bryant Electric Company, Pass & Seymour, or equal.

2.02 WIRING DEVICES

- A. Wiring devices shall be in accordance with the following for nonhazardous areas:

1. Wall Switches, Single Pole, 20 A, 120-277V equivalent to Hubbell No. 1221, Pass & Seymour No. 20AC1, Leviton equivalent, or equal. Switches rated 30 A, 120-277V shall be Leviton 3031, Hubbell equivalent, Pass & Seymour equivalent, or equal.
2. Wall Switches, Double Pole, 20 A, 120-277V equivalent to Hubbell No. 1222, Pass & Seymour No. 20AC2, Leviton equivalent, or equal. Switches rated 30 A, 120-277V shall be Leviton 3032, Hubbell equivalent, Pass & Seymour equivalent, or equal.
3. Wall Switches, Three-Way, 20 A, 120-277V equivalent to Hubbell No. 1223, Pass & Seymour No. 20AC3, Leviton equivalent, or equal. Switches rated 30 A, 120-277V shall be Leviton 3033, Hubbell equivalent, Pass & Seymour equivalent, or equal.
4. Wall Switches, Four-Way, 20 A, 120-277V equivalent to Hubbell No. 1224, Pass & Seymour No. 20AC4, Leviton equivalent, or equal.
5. Convenience Receptacles 20 A, 125V, duplex polarized with grounding connection equivalent to Hubbell No. 5362, Pass & Seymour equivalent, Leviton equivalent, or equal.
6. Hubbell Cat. No. GF-5362, Pass & Seymour equivalent, Leviton equivalent, or equal, for 20A, 120V, duplex, ground fault circuit interrupting type.

- B. For hazardous areas the following shall be provided:

1. Wall Switches, single pole, 20 A, 120 V equivalent to Crouse Hinds Cat. No. EFD3591 or EFDC3591 (as required); Appleton No. EDS175F1 or EDSC175F1, Killark equivalent, or equal.
2. Convenience Receptacles 20 A, 120-250 VAC, 2 wire, 3 pole equivalent to Crouse Hinds Cat. No. CPS152-201, Appleton No. CPE1-2375, Killark equivalent, or equal.

- C. Plugs for hazardous and non-hazardous receptacles shall be provided:

1. Plugs and respective cable shall be provided for equipment furnished under other Divisions (steam cleaners, welders, etc.) as necessary.

2.03 DEVICE PLATES

- A. Wall plates with gaskets for flush-mounted receptacles and switches shall be made of Type 304 stainless steel, not less than 0.040 of an inch thick, with beveled edges and milled on the rear so as to lie flat against the wall. Wall plates shall be equivalent to Hubbell Series 9600, Pass & Seymour series 93000, Leviton equivalent, or equal.

- B. Device plates for weatherproof and watertight installations shall be Appleton Type FSK, Crouse-Hinds #DS185, or equal for wall switches and Appleton Type FSK, Crouse-Hinds #WLRD, or equal for convenience receptacles. "In-use" weatherproof covers shall be rugged, die-cast aluminum as manufactured by Thomas & Betts "Red Dot," or equal.

2.04 PLUGS

- A. The CONTRACTOR shall furnish suitable plugs with equipment furnished under the respective Contract. 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 equal. For hazardous locations, the device shall be a front operated general use snap switch mounted in an EFS enclosure as manufactured by Crouse-Hinds, Appleton equivalent, or equal.

PART 3 -- EXECUTION

3.01 INSTALLATION

- A. Switch boxes shall be of unit construction and of sizes as required to adequately house the number of switches required. No sectional type switch boxes shall be permitted.
- B. Where more than one switch occurs at one point, gang plates shall be used.
- C. All device plates shall be set true and plumb, and shall fit tightly against the finished wall surfaces and outlet boxes.
- D. All devices shall be flush-mounted in finished areas, unless otherwise noted. The CONTRACTOR shall determine the proper position of every outlet, and relocate any outlet without additional cost to the City if same is incorrectly or improperly located. The ENGINEER reserves the right to change the location of any outlet or connecting equipment up to the time of roughing in without additional cost to the City, provided conduit runs are not increased by more than ten feet.
- E. In all areas where thermal or acoustic insulation is applied to the ceiling or walls, outlet boxes shall be set to finish flush with the finished surface of the insulation.
- F. 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.

G. For the below-named items, mounting heights from finish floor, or finish grade to top is applicable. Mounting heights shall be as follows, unless otherwise specified herein, indicated on the Drawings, or required by the Americans with Disability Act (ADA):

1. Single-pole light switches, 48 inches.
2. Duplex receptacles in dry areas, 16 inches
3. Duplex receptacles in pump rooms, 48 inches

3.02 CIRCUITING

A. Convenience receptacles shall be grouped on circuits separate from the lighting circuits. A maximum of eight convenience receptacles are permitted per 20A, 120V circuit.

- END OF SECTION -

SECTION 16160 - CABINETS AND ENCLOSURES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The CONTRACTOR shall furnish and install all cabinets and enclosures to house electrical controls, instruments, terminal blocks, and similar devices as shown on the Drawings and specified herein.
- B. Cabinets and enclosures shall conform to all applicable UL and NEMA standards. Materials and components shall be new and conform to grades, qualities and standards as specified herein and shown on the Drawings.
- C. Reference Section 16000, Basic Electrical Requirements and Division 17, Control and Information Systems.

1.02 TESTING

- A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 1. The following tests are required:
 - 1. Witnessed Shop Test
 - a. None required.
 - 2. Shop Test
 - a. The cabinets and enclosures shall be given routine factory tests in accordance with the requirements of UL, NEMA, and the manufacturer's standards.
 - 3. Field Tests
 - a. None required.

1.03 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01300, Submittals, 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.
 - 2. Complete assembly, layout, and installation drawings for each cabinet and enclosure 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.
- B. All cabinets and enclosures must bear the label of approval of the Underwriters Laboratories, Inc. or other nationally recognized testing laboratory that is accepted by the NEC.
- C. Cabinets and enclosures for non-hazardous locations shall be as manufactured by Hoffman Engineering Company, Rittal Corporation, The Austin Company, or equal. Enclosures for hazardous locations shall be as manufactured by the Appleton Electrical Company, Crouse-Hinds, O-Z/Gedney, or equal.

2.02 CABINETS AND ENCLOSURES

- A. Ratings
 - 1. Unless otherwise specified herein or shown on the Drawings, cabinets and enclosures shall be:
 - a. NEMA 1 when located in environmentally controlled spaces such as control rooms, electric rooms, and similar locations.
 - b. NEMA 12 (gasketed) when located in dry, indoor process areas.
 - c. NEMA 4X Aluminum or Type 316 stainless steel when located in damp/wet, indoor, corrosive process areas.
 - d. NEMA 4X Aluminum or Type 316 stainless steel for all outdoor locations.
 - e. Suitable for the specific Class, Division, and Group when located in hazardous locations.

B. Construction - Aluminum

1. Enclosures shall be fabricated in accordance with U.L. specifications from Code Gauge Type 5052 H-32 gauge aluminum with seams that are continuously welded. Doors shall have full length piano hinges with the door removable by pulling the hinge pin.
2. A rolled lip shall be provided around three sides of the door and around all sides of the enclosure opening. The gasket shall be attached with oil-resistant adhesive and held in place with steel retaining strips. Exterior hardware, such as clamps, screws, and hinge pins, shall be stainless steel. Door latches for NEMA 4X cabinets and enclosures shall be all stainless steel, quick release (fast operating) clamp assemblies that do not require bolts or screws to secure. A hasp and staple shall be provided for padlocking. Interior panels shall be provided. Each enclosure shall have a print pocket.
3. Aluminum, NEMA 4X enclosures and enclosures suitable for hazardous locations shall be unpainted. Interior panels shall be unpainted aluminum.

PART 3 -- EXECUTION

3.01 INSTALLATION

- A. Cabinets and enclosures shall be installed as shown on the Drawings and in accordance with the manufacturer's installation instructions.

- END OF SECTION -

SECTION 16170 - GROUNDING AND BONDING

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The CONTRACTOR shall furnish and install grounding systems complete in accordance with the minimum requirements established by Article 250 of the NEC. Article 250 of the NEC shall be considered as 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 1100-92, Powering and Grounding of Sensitive Electronic Equipment. Conflicts shall be promptly brought to the attention of the ENGINEER.
- C. In addition to the NEC requirements, building structural steel columns and metallic chemical storage tanks shall be permanently and effectively grounded.
- D. Reference Section 16000, Basic Electrical Requirements.

1.02 TESTING

- A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 1. 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 1, and NETA acceptance testing specifications referenced in Section 16000, Basic Electrical Requirements.

1.03 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01300, Submittals, 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 5/8 inch in diameter by 10 feet in length. The copper cladding 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. The ground rods shall be manufactured by Erico Products, Blackburn, or equal.
- B. The maximum resistance to ground of a driven ground rod shall not exceed five ohms under normally dry conditions. Where the resistance obtained with one ground rod exceeds five ohms, additional ground rods shall be installed not less than 8 feet on centers. Due to soil conditions and/or other unforeseen field conditions, ground resistances greater than five ohms may be acceptable if approved by the ENGINEER.
- C. 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.
- D. The ground connection shall be made at the main service equipment and shall be extended 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. If there is not suitable metallic water service to the facility, the ground connection shall be made to the driven ground rods on the exterior of the building.

- E. 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 may be made by use of the crucible weld process or bolted type connectors. Bolted type connectors for this application shall consist of corrosion resistant copper alloy with silicone bronze bolts, nuts and lockwashers which are designed for this purpose.

2.04 GROUNDING CONDUCTORS

- A. A green, insulated equipment grounding conductor, which shall be separate from the electrical system neutral conductor, shall be furnished and installed for all circuits. 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.

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. The ground rods shall be driven deep enough to obtain a ground resistance of not more than 5 ohms and shall be interconnected by the use of copper cable bus exothermically welded to the rods. Due to soil conditions and/or other unforeseen field conditions, ground resistances greater than five (5) ohms may be acceptable if approved by the ENGINEER. 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 system and shall enter the buildings and structure from the outside and shall be connected to steel structures, and equipment as described in this Section and as required to provide a complete grounding system.

2. Grounding conductors shall be continuous between points of connection; splices shall not be permitted.
3. 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.
4. Connections to ground rods shall be exposed to permit maintenance and inspection for continuity and effectiveness of 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.

C. Raceways

1. Conduit which enters equipment such as switchgear, 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.

- END OF SECTION -

SECTION 16190 - SUPPORTING DEVICES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The CONTRACTOR shall furnish and install structural aluminum or stainless steel supports for mounting and installing all electrical, lighting, alarm systems, instrumentation, and communications equipment furnished under this Contract.
- B. Equipment shall be installed strictly in accordance with recommendations of the manufacturer 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. Reference Section 16000, Basic Electrical Requirements.

1.02 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01300, Submittals, the CONTRACTOR shall obtain from the equipment manufacturer and submit shop drawings. Each submittal shall be identified by the applicable Specification section.

1.03 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. Materials used in accordance with this Section shall be as specified herein.

PART 3 -- EXECUTION

3.01 INSTALLATION

A. Concrete or Masonry Inserts

1. The CONTRACTOR shall be responsible for the furnishing and installation of all conduit sleeves, 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 steel channels for all switchgear, switchboards, motor control centers, and similar equipment. The leveling steel channels shall be provided for installation in the equipment supporting pads. Coordination of the installation of these channels with the concrete pad is essential and required. Pad height shall be as required to maintain coverage of the reinforcement bars while not exceeding the maximum mounting heights 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. Where supports or hangers are required for heavy electrical equipment units exceeding fifty pounds, a professional ENGINEER registered in the State of Florida shall check the structural framing. Where required, additional sections shall be provided for a safe installation. Supports and hangers shall be aluminum or 316 stainless steel as required to suit the application and shall be compatible with the balance of the installation.
2. All holes in hung ceilings for support rods, conduits, and other equipment shall be made adjacent to bars where possible, to facilitate removal of ceiling panels.
3. For interior dry areas, a bracket and channel type support of aluminum construction shall be provided wherever required for the support of starters, switches, panels, and miscellaneous equipment.
4. For outdoor service or in indoor damp/wet process areas, the support system shall be made of Type 316 stainless steel or aluminum. The materials of construction

shall be coordinated with the process/chemical area in which the support system will be installed.

5. All hardware (bolts, nuts, washers, etc.) shall be Type 316 stainless steel.
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. Wherever this occurs, a provision shall be made for ready access to the wiring for connections to the equipment by means of boxes with screw covers.
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 channels and bracket with a plate for mounting the components. The CONTRACTOR is responsible for the design of supporting structure; he 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.

- END OF SECTION -

SECTION 16195 - ELECTRICAL - IDENTIFICATION

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 switchgear, switchboards, motor control centers, variable frequency drives, lighting and distribution panelboards, combination starters, control panels, pull/junction boxes, enclosures, disconnect switches, control stations, and similar 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 01300, Submittals, 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 with white lettering.

2.03 HIGH VOLTAGE SIGNS

- A. Standard "DANGER" signs shall be of baked enamel finish on 20 gage 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 16111, Conduit.

2.05 WIRE AND CABLE IDENTIFICATION

- A. Field installed wire and cable identification shall be as specified in Section 16123, Building Wire and Cable.
- B. Wiring identification for factory installed wiring in equipment enclosures shall be as specified in the respective section.

2.06 ARC FLASH IDENTIFICATION

- A. Arc flash labeling shall be installed as required by the NEC and NFPA 70E.

PART 3 -- EXECUTION

3.01 NAMEPLATES

- A. Nameplates shall be attached to the equipment enclosures with two stainless steel sheet metal screws for nameplates up to 2-inches wide. For nameplates over 2-inches wide, four

stainless steel sheet metal screws shall be used, one 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 (i.e. valves, motors, 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 CITY regarding exact nameplate placement during construction.
- C. Nameplates shall be as specified herein.

- END OF SECTION -

SECTION 16440 - DISCONNECT SWITCHES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The CONTRACTOR shall furnish and install separately mounted, individual disconnect switches as specified herein and indicated on the Drawings.
- B. Reference Section 16000, Basic Electrical Requirements.

1.02 TESTING

- A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 1. 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 1, and NETA acceptance testing specifications as referenced in Section 16000, Basic Electrical Requirements.

1.03 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01300, Submittals, 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.
 - 2. Complete layout and installation drawings with clearly marked dimensions for each type/size/rating of disconnect switch.
 - 3. Assembled weight of each unit.
- 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.

1.05 TOOLS, SUPPLIES, AND SPARE PARTS

- A. The equipment shall be furnished with all special tools necessary to disassemble, service, repair, and adjust the equipment, and with all spare parts as recommended by the equipment manufacturer.
- B. One (1) complete set of spare fuses for each ampere rating installed shall be furnished and delivered to the City at the time of final inspection.
- C. Spare parts lists, included with the shop drawing submittal, 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.
- D. 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 switch, shall have the same parts number.

1.06 IDENTIFICATION

- A. Each equipment item shall be identified with a nameplate plus all other required safety labeling. The nameplate shall be engraved indicating the circuit number and equipment name with which it is associated. Equipment identification shall be in accordance with Section 16195, Electrical - Identification.

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. Switches shall be manufactured by the Eaton Corporation, Square D Company, or the General Electric Company.

2.02 DISCONNECT SWITCHES

- A. Disconnect switches shall be heavy-duty type and/or as specified in these Specifications. Switches shall be furnished and installed as shown on the Drawings and as required by the NEC. Handles shall be lockable.
- B. Switches shall be NEMA Type HD, single-throw, externally operated, fused or non-fused as required. Switches of the poles, voltage, and ampere ratings shown shall be furnished in NEMA 1A (gasketed) enclosures in indoor dry areas, and in NEMA 4X Type 316 stainless steel enclosures for damp/wet indoor process areas. Enclosures for outdoor applications shall be NEMA 4X aluminum or Type 316 stainless steel. Switches located in hazardous areas shall be suitable for the Class, Division, and Group to suit the application. Enclosures for switches located in sodium hypochlorite storage and transfer areas shall be NEMA 4X nonmetallic.
- C. Disconnect switches shall be quick-make, quick-break and with an interlocked cover which cannot be opened when switch is in the "ON" position and capable of being locked in the "OPEN" position.
- D. A complete set of fuses for all switches shall be furnished and installed as required. Time-current characteristic curves of fuses serving motors or connected in series with circuit breakers shall be coordinated for proper operation. Fuses shall have voltage rating not less than the circuit voltage.
- E. Fused disconnect switches shall be furnished for all motor operated valve and gate actuators unless otherwise noted. The CONTRACTOR shall coordinate the supply of these fused switches with the specific requirements of the actuator. Fuses with fast fault clearing times may be required for modulating valve actuators.

PART 3 -- EXECUTION

3.01 INSTALLATION

- A. All disconnect switches shall be mounted with the top of disconnect at 66" above the floor unless otherwise indicated or if conditions suggest that a different height is more appropriate.
- B. The CONTRACTOR shall furnish and install fuses of various types as required with the continuous ampere ratings as required or shown on the Drawings.

- END OF SECTION -

SECTION 16470 - PANELBOARDS

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. The CONTRACTOR shall furnish and install panelboards of voltage and current ratings as specified herein and indicated on the Drawings. Panelboards shall be furnished with circuit breaker ratings, number of breakers, number of poles and locations conforming with the panelboard schedules on the Drawings.
- B. Reference Section 16010, Basic Electrical Requirements.

1.02 CODES AND STANDARDS

- A. Panelboards shall conform to all applicable Federal, UL, and NEMA standards. Materials and components shall be new and conform to grades, qualities and standards as specified herein and shown on the Drawings.
- B. Panelboards shall comply with the following industry standards:
 - 1. UL Listing/Approval
 - 2. UL Standards
 - a. Panelboards - UL 67
 - b. Cabinets and Boxes - UL 50
 - 3. National Electrical Code
 - 4. NEMA Standard - PB1

1.03 TESTING

- A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 1. 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 1, and Section 16010, Basic Electrical Requirements.

1.04 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01300, Submittals, the CONTRACTOR shall obtain from the equipment manufacturer and submit the following:
 - 1. Shop Drawings.
 - 2. Reports of Certified Shop Tests.
 - 3. Spare Parts List.
 - 4. Operation and Maintenance Manuals.
- B. 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.
 - 2. Complete assembly, layout, and installation drawings with clearly marked dimensions for each panelboard.
 - 3. Complete panelboard schedules indicating circuit designations and connected loads as shown on the Drawings for each panelboard.
- D. The submittal information shall reflect the specific equipment identification number as indicated on the Drawings.

1.06 TOOLS, SUPPLIES AND SPARE PARTS

- A. The panelboards and accessories shall be furnished with all special tools necessary to disassemble, service, repair, and adjust the equipment. 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.
- B. Spare parts lists, included with the shop drawing submittal, 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. 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.

1.07 IDENTIFICATION

- A. Each panelboard shall be identified with the identification 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 16010, Basic Electric Requirements

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.

2.02 CONDUCTORS (MAIN BUS AND BRANCH CONNECTORS)

- A. All main bus shall be copper sized in accordance with UL standards to limit the temperature rise on any current carrying part to a maximum of 50 degrees C above a maximum ambient temperature of 40 degrees C.

2.03 LIGHTING PANELBOARDS

A. General

1. Lighting panelboards shall be dead-front type with automatic trip-free, non-adjustable, thermal-overload, branch circuit breakers. Panelboards shall be of the configuration and rating as specified herein and indicated on the Drawings. Panelboards shall be service entrance rated where indicated on the Drawings.
2. Lighting panelboards shall be equipped with a main breaker or main lugs complete with branch circuit breakers, as indicated on the Drawings. The panelboards shall be suitable for flush or surface mounting. Some panelboards shall be furnished and installed within motor control center structures as shown on the Drawings.
3. Lighting panelboards shall be fully rated and shall have a minimum short circuit rating of 10,000 amperes symmetrical, unless otherwise indicated on the Drawings.
4. Lighting panelboards shall be Eaton Corporation Pow-R-Line Series, the Square D Company equivalent, or the General Electric Company equivalent.

B. Enclosures

1. Except for lighting panelboards installed in motor control centers, the enclosure shall be NEMA 12 unless otherwise indicated on the Drawings, constructed of No. 12 U.S.S. code gauge galvanized steel. The door shall be fastened to the enclosure with concealed hinges and shall be equipped with flush-type catches and locks. All locks shall be keyed alike. The enclosure shall have wiring gutters on sides and shall be at least 5-3/4 inches deep. The panelboard shall be provided with an information label. The information label shall include the panelboard designation, voltage, phase, wires, and bus rating.

2. All metal surfaces of the panelboard enclosures shall be thoroughly cleaned and given one prime of zinc chromate primer. All interior surfaces shall then be given one shop finishing coat of a lacquer of the nitro-cellulose enamel variety. All exterior surfaces shall be given three coats of the same lacquer. The color of finishing coats shall be light gray ANSI #61.
3. An Underwriter's Laboratories, Inc. inspection label shall appear on the interior of the cabinet.

C. Bus Work

1. 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 so as to provide full flexibility of circuit arrangement.
2. Solid neutral bus bars are required. Ratings shall be in accordance with applicable standards.
3. A separate ground bus shall be provided with lugs for termination of equipment grounding conductors.
4. Branch bus work shall be rated to match the maximum branch circuit breaker which may be installed in the standard space.
5. All bus shall be tin plated copper and shall extend the entire useable length of the panelboard, including spaces.

D. Circuit Breakers

1. Circuit breakers shall be bolt-on, molded-case type conforming to NEMA Standard AB 1. All circuit breakers shall have quick-make, quick-break, toggle mechanism for manual as well as automatic operation. Tandem or half-size circuit breakers are not acceptable. Branch circuit breakers used for control, instrumentation, telephone, fire alarm, or auxiliary equipment circuits requiring continuous operation shall be provided with a lock-on device.
2. Where indicated, or where required by Code, circuit breakers for receptacle circuits shall be equipped with integrally mounted ground fault interrupters complete with "TEST" push button and shall be of a type which fit standard panelboard spaces for the breaker continuous current rating required. 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.
3. Circuit breaker voltage ratings shall meet or exceed the panelboard voltage indicated on the Drawings. Trip elements of circuit breakers shall be 20A unless otherwise indicated on the Drawings. Circuit breakers shall have an interrupting rating at 240 VAC that matches the panelboard short circuit rating.

E. Directories

1. Approved directories with glass or noncombustible plastic cover, and with typewritten designations of each branch circuit, shall be furnished and installed in each panelboard. The CONTRACTOR shall maintain in each panel, 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 with the panelboard schedules on the Drawings, except as otherwise authorized by the ENGINEER.

F. Surge Protective Devices

1. The lightning panelboards shall be furnished with integrated Type II surge protective devices (SPD). SPDs shall be provided in the location and quantity as shown on the Drawings.
2. The SPD shall be rated, designed, tested, listed, and labeled in accordance with UL-1449, third edition. Products labeled in accordance with previous editions of UL-1449 are not acceptable.
3. The SPD shall be factory installed by the lightning panelboard manufacturer using a direct bus connection. There shall be no cable connection between the bus bar and the SPD device.
4. The SPD shall have a fault current rating equal to or greater than that of the fault current rating of the lightning panelboard. The SPD shall employ metal-oxide varistor (MOV) technology. If integral fusing is used, the fuses shall allow the maximum rated surge current to pass without fuse operation.
5. The SPD shall have a maximum continuous operating voltage (MCOV) of at least 115% of the nominal voltage of the switchgear. The Voltage Protection Rating (VPR) of the SPD shall be submitted for ENGINEER review.
6. The Nominal Discharge Current (In) of the SPD shall be 20kA, minimum. Peak surge current ratings shall not be used as a basis for applying the SPD to the system.
7. The SPD shall provide ten modes of protection for Wye connected systems, and seven modes of protection for Delta connected systems.
8. The SPD shall be furnished with an audible alarm and silence pushbutton, integral SPD status LEDs (one per phase), and a Form C dry contact for remote indication of alarm. A surge counter shall also be provided.
9. The SPD equipment shall be Clipper Power System by Eaton Corporation, SurgeLogic by the Square D Company, or Tranquell by the General Electric Company.

2.04 POWER DISTRIBUTION PANELBOARDS

A. General

1. Power distribution panelboards shall be of the configuration and rating as specified herein and as indicated on the Drawings. The panelboards shall be dead front type with automatic trip-free, non-adjustable, thermal overload branch circuit breakers. Panelboards shall be service entrance rated where indicated on the Drawings.
2. Power panelboards shall be equipped with a main breaker or main lugs complete with branch circuit breakers as indicated on the Drawings. The panelboards shall be suitable for flush or surface mounting. Some panelboards shall be furnished and installed within motor control center structures as shown on the Drawings.
3. Power distribution panelboards shall be fully rated and shall have a minimum short circuit rating of 65,000 amperes symmetrical unless otherwise indicated on the Drawings.
4. Power distribution panelboards shall be Eaton Corporation Pow-R-Line Series, the Square D Company equivalent, or the General Electric Company equivalent.

B. Enclosures

1. Except for power panelboards installed in motor control centers, the enclosures shall be NEMA 12 unless otherwise indicated on the Drawings, constructed of No. 12 U.S.S. code gauge galvanized steel. The door shall be fastened to the enclosure with concealed hinges and shall be equipped with flush type catches and locks. All locks shall be keyed alike. The enclosure shall have wiring gutters on sides and shall be at least 5 3/4 inches deep. The panel shall be provided with an information label. The information label shall include the panelboard designation, voltage, phase, wires, and bus rating.
2. All metal surfaces of the panelboard enclosures shall be thoroughly cleaned and given one prime of zinc chromate primer. All interior surfaces shall then be given one shop finishing coat of a lacquer of the nitro cellulose enamel variety. All exterior surfaces shall be given three coats of the same lacquer. The color of finishing coats shall be light gray ANSI #61.
3. An Underwriter's Laboratories, Inc. inspection label shall appear on the interior of the cabinet.

C. Bus Work

1. Main bus bars shall be of ample size so that a current density of not more than 1,000 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 so as to provide full flexibility of circuit arrangement.
2. Solid neutral bus bars, where required, shall be provided. Ratings shall be in accordance with applicable standards.
3. A separate ground bus shall be provided with lugs for termination of equipment grounding conductors.

4. Branch bus work shall be rated to match the maximum branch circuit breaker which may be installed in the standard space.
5. All bus shall be tin plated copper and shall extend the entire useable length of the panelboard, including spaces.

D. Circuit Breakers

1. Circuit breakers shall be bolt-on, molded-case type conforming to NEMA Standard AB 1. All circuit breakers shall have quick-make, quick-break, toggle mechanism for manual as well as automatic operation.
2. Circuit breakers used for lighting circuit switching shall be approved for the purpose and shall be marked "SWD" where required by Article 440 by the NEC. Circuit breakers installed for air conditioning units shall be HACR type.
3. Circuit breaker voltage rating shall meet or exceed the panelboard voltage indicated on the Drawings. Trip elements of circuit breakers shall be 20A, unless otherwise indicated on the Drawings. Circuit breakers shall have an interrupting rating at 480 VAC that matches the panelboard short circuit rating.

E. Directories

1. Approved directories with glass or noncombustible plastic cover, and with typewritten designations of each branch circuit, shall be provided in each panel. The CONTRACTOR shall maintain in each panel, 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 with the panelboard schedules on the Drawings, except as otherwise authorized by the ENGINEER.

F. Surge Protective Devices

1. The power panelboards shall be furnished with integrated Type II surge protective devices (SPD). SPDs shall be provided in the location and quantity as shown on the Drawings.
2. The SPD shall be rated, designed, tested, listed, and labeled in accordance with UL-1449, third edition. Products labeled in accordance with previous editions of UL-1449 are not acceptable.
3. The SPD shall be factory installed by the power panelboard manufacturer using a direct bus connection. There shall be no cable connection between the bus bar and the SPD device.
4. The SPD shall have a fault current rating equal to or greater than that of the fault current rating of the power panelboard. The SPD shall employ metal-oxide varistor (MOV) technology. If integral fusing is used, the fuses shall allow the maximum rated surge current to pass without fuse operation.

5. The SPD shall have a maximum continuous operating voltage (MCOV) of at least 115% of the nominal voltage of the switchgear. The Voltage Protection Rating (VPR) of the SPD shall be submitted for ENGINEER review.
6. The Nominal Discharge Current (In) of the SPD shall be 20kA, minimum. Peak surge current ratings shall not be used as a basis for applying the SPD to the system.
7. The SPD shall provide ten modes of protection for Wye connected systems, and seven modes of protection for Delta connected systems.
8. The SPD shall be furnished with an audible alarm and silence pushbutton, integral SPD status LEDs (one per phase), and a Form C dry contact for remote indication of alarm. A surge counter shall also be provided.
9. The SPD equipment shall be Clipper Power System by Eaton Corporation, SurgeLogic by the Square D Company, or Tranquell by the General Electric Company.

2.05 COMBINATION POWER UNITS

- A. The CONTRACTOR shall furnish and install a combination power unit as specified herein and indicated on the Drawings. The unit shall be a combination of a dry type transformer and a lighting panelboard. Transformer rating and panelboard bus rating shall be as indicated on the Drawings. The transformer and panelboard shall meet the requirements for these products as specified herein and elsewhere in these Specifications. Combination power units located outdoors shall be suitable for outdoor use and rated NEMA 3R.
- B. The combination power unit shall be a Mini-Power Zone as manufactured by the Square D Company, a Mini-Power Center as manufactured by Cutler-Hammer, Servicecenter as manufactured by General Electric Company, or Siemens Energy and Automation, Inc. equivalent.

PART 3 – EXECUTION

3.01 MOUNTING

- A. Panelboards and combination power units shall be furnished and installed as shown on the Drawings and as recommended by the equipment manufacturer.
- B. Panelboards shall be set true and plumb in locations as shown on the Drawings. The top of panelboard enclosure shall not exceed six 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 back boxes. The CONTRACTOR shall punch or drill required openings during installation and shall equip flush back boxes with manufacturer's standard pattern of knockouts. The CONTRACTOR shall equip cabinet doors exceeding 40 inches in height with vertical bolt three point locking mechanism.
- E. The CONTRACTOR shall install cabinets (and other enclosure products) in plumb with the building construction. Flush enclosures shall be installed so that the trim will rest against the surrounding surface material and around the entire perimeter of the enclosure.
- F. 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 RUBBER MATS

- A. A three foot wide rubber mat shall be furnished and installed on the floor and in front of each panelboard. The mat shall be long enough to cover the full length of each panelboard. The mat shall be located so as not to obstruct the movement of the panel door. The mat shall be 1/4 inch thick with beveled edges, canvas back, solid type with corrugations running the entire length of the mat. The mat shall be guaranteed extra quality, free from cracks, blow holes, or other defects detrimental to their mechanical or electrical strength. The mat shall meet OSHA requirements and the requirements of ANSI/ASTM D-178 J6-7 for Type 2, Class 2 insulating matting.

-- END OF SECTION --

SECTION 16482 - MOTOR CONTROL CENTERS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The CONTRACTOR shall furnish, install, test, and place in satisfactory operation, the motor control centers as specified herein and indicated on the Drawings.
- B. The CONTRACTOR shall obtain the motor control centers from one manufacturer who shall also manufacture the enclosure and major equipment components, which includes, but is not limited to, combination starters, variable frequency drives, required voltage solid state starters, branch circuit breakers, main circuit breakers, power monitoring equipment, and other components of the equipment assembly. Subcontracting of wiring is not acceptable.
- C. The motor control center 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.
- D. Motor control circuits shall be wired in accordance with the requirements specified herein or indicated on the Drawings. Where not indicated, the control circuits shall be standard three-wire "start-stop" and the CONTRACTOR shall furnish wiring accordingly.
- E. Reference Section 16000, Basic Electrical Requirements; Section 16195, Electrical Identification; Section 16902, Electric Controls and Relays; and Section 16495, Variable Frequency Drive Systems.

1.02 CODES AND STANDARDS

- A. The assemblies shall meet or exceed the requirements within the following standards for motor control centers:
 - 1. NEMA ICS-18
 - 2. UL845
 - 3. NEC (NFPA 70)
 - 4. CSA (cUL)
 - 5. EN 60439
- B. The motor control center shall be designed, manufactured, and tested in facilities registered to the following quality standards:
 - 1. ISO 9001

1.03 TESTING

- A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 1. The following tests are required:

1. Shop Tests

- a. The motor control center specified in this Section shall be shop tested and inspected in accordance with the equipment manufacturer's standard procedures. The testing and inspection procedures shall demonstrate that the equipment tested conforms to the requirements specified.

2. Certified Shop Tests and Reports

- a. Submit description of proposed testing methods, procedures, and apparatus. Submit notarized and certified copies of all test reports.
- b. As a minimum, the entire motor control center shall go through a quality inspection before shipment. This inspection shall include, but is not limited to, the following:
- i. Physical inspection of the structure and the electrical conductors including bussing, general wiring, and units.
 - ii. General electrical tests including power circuit phasing, control circuit wiring, instrument transformers, meters, ground fault system, and device electrical operation.
 - iii. AC dielectric tests of the power circuits and control circuits.
 - iv. Markings/labels, including instructional type, Underwriters Laboratory (UL), and inspector's stamps.
- c. The manufacturer shall use integral quality control checks throughout the manufacturing process to maintain the correctness of the motor control center.

3. Field Tests

- a. Field tests shall be performed in accordance with the requirements specified in the General Conditions, Division 1, and Section 16000, Basic Electrical Requirements.

1.04 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01300, Submittals, the CONTRACTOR shall obtain from the equipment manufacturer and submit the following:

1. Shop Drawings.

2. Spare Parts List.
3. Special Tools List.
4. Proposed Testing Methods and Reports of Certified Shop and Field Tests.
5. Operation and Maintenance Manuals.

B. 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 for each motor control center shall include but not be limited to:
 1. Product data sheets.
 2. Example equipment nameplate data sheet.
 3. Approximate total shipping weight of each shipping split.
 4. Plan, front, and side view drawings, including overall dimensions of each motor control center. Identify shipping splits and show conduit stub-up area locations on the Drawings.
 5. Internal schematic and point-to-point wiring diagrams of each motor control unit including variable frequency drives and reduced voltage solid state starters integrated into the motor control center. One wiring diagram which is typical for an equipment group (e.g. Oxidation Ditch Rotor, Grit Drive, etc.) 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.
 6. Complete single-line diagrams for each motor control center showing circuit breakers, motor circuit protectors, motor controllers, instrument transformers, meters, relays, timers, control devices, and other equipment comprising the complete assembly. Indicate electrical ratings of equipment and devices on these single-line diagrams. Ratings include starter size and type, circuit breaker frame size and trip rating, transformer ratings, panelboard ratings, motor horsepower and full load current, and similar information.
 7. Bill of material list for each motor control center and each motor control unit.

8. Nameplate schedule for each motor control center.
 9. Manufacturer's installation instructions.
 10. 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 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 each motor control center unit of each motor control center. These final drawings shall be included in the O&M manuals.
- 1.06 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 1.
- 1.07 TOOLS, SUPPLIES AND SPARE PARTS
- A. The motor control center and accessories shall be furnished with all special tools necessary to disassemble, service, repair, and adjust the equipment. All spare parts as recommended by the equipment manufacturer shall be furnished to the City by the CONTRACTOR.

The CONTRACTOR shall furnish the following spare parts for each motor control center:

No. Required	Description
1 set	Fuses of each size provided
1	Starter coil and complete set of contacts for each size and type of starter provided.
1	Relay of each size and type used.
1	Control power transformer of each size used.
5	Lamps and lenses for indicating lights, each color.
1	Indicating lamp sockets for each type used.
1 set	Overload relay with heaters for each type, size, and rating used.
1	Pilot device (e.g. pushbutton, selector switch, etc) complete with contact blocks and legend plates for each type, color, size and rating used.
1	Motor circuit protector for each type, size, and rating used.
1	Molded case circuit breaker for each type, size, and rating used (except main circuit breakers).

- B. The 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.
- C. 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 City.
- D. Spare parts lists, included with the shop drawing submittal, 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.
- E. Parts shall be completely identified with a numerical system to facilitate parts 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.

1.08 SERVICE OF MANUFACTURER'S REPRESENTATIVE

- A. The CONTRACTOR shall provide the services of a qualified manufacturer's technical representative who shall adequately supervise the installation and testing of all equipment furnished under this Contract and instruct the CONTRACTOR's personnel and the City's operating personnel in its maintenance and operation as outlined elsewhere in Division 1 and Section 11000, Equipment - General Provisions. The services of the manufacturer's representative shall be provided for a period of not less than as follows:
 - 1. One trip of one working day during installation of the equipment for each motor control center.
 - 2. One trip of one working day after acceptance of the equipment.
 - 3. One trip of one working day during the warranty period.
- B. Any additional time required to achieve successful installation and operation shall be at the expense of the CONTRACTOR. The manufacturer's representative shall sign in and out each day he is at the project.

1.09 IDENTIFICATION

- A. Each motor control center shall be identified with the identification number indicated on the Drawings. A nameplate shall be securely affixed in a conspicuous place on each motor control center. Nameplates shall be as specified in Section 16195, Electrical - Identification.

1.10 TRAINING

- A. The CONTRACTOR shall provide training for City personnel. Training shall be conducted by the manufacturer's factory trained specialists who shall instruct City personnel in operation and maintenance of all equipment provided under this Section. Training shall be in accordance with the requirements of Section 11000, Equipment-General Provisions.

1.11 CONSTRUCTION SEQUENCING

- A. The CONTRACTOR shall reference Section 01520, Maintenance of Facilities and Sequence of Construction, of these Specifications.

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. It is the intent of these specifications that all components of the motor control center be provided by one manufacturer who shall have the sole responsibility of matching all components and providing equipment which functions together as a system. The manufacturer of the motor control center shall also be the manufacturer of the motor controllers. The use of third-party supply and assembly of these components is not acceptable.
- C. Motor control centers shall be Freedom 2100 as manufactured by Cutler-Hammer using NEMA rated Freedom Series contactors and starters, Square D or General Electric.

2.02 MOTOR CONTROL CENTER

A. General

- 1. The motor control centers shall be 600 VAC class suitable for operation on a three-phase, 60 Hz system. The motor control centers and their components shall conform to the requirements of applicable standards of NEMA Part ICS 2-322 and Underwriters' Laboratories, Inc. UL-845. Wiring shall be NEMA Class II, Type B. Each vertical section shall be a NEMA 1A (gasketed) industrial use enclosure unless otherwise specified or indicated on the Drawings.
- 2. The motor control centers shall be capable of withstanding the fault current available at its line terminals. Minimum bus bracing, withstand, and interrupting ratings are specified herein.
- 3. Unless otherwise specified or indicated on the Drawings, each vertical section shall be approximately 20 inches wide, and 90 inches high, 20 inches deep, and shall not contain more than six NEMA Size 1 starters. Motor control centers shown "back-to-back" on the Contract Drawings shall be complete motor control assemblies placed back-to-back in the location shown. Motor control center sections with common horizontal and/or vertical bus systems are unacceptable.
- 4. Continuous horizontal wiring troughs shall be provided at both the top and bottom of each section. These troughs shall line up to form a continuous wireway for the full length of the motor control center. Each section shall be provided with a large, continuous, full height vertical wiring trough in the right side of each section. Each vertical wiring trough shall be furnished complete with tie bars for conductor support.

5. Each combination motor controller unit shall be equipped with an individual, fused, control power transformer of sufficient capacity to power all connected devices, i.e. solenoid valves, motor space heaters and control circuits.
6. 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 105°C. Wire color coding shall be red for control and black for power. Wire numbers shall not be repeated in a motor control center.
7. Starter units shall contain the number of auxiliary contacts, unit-mounted pilot devices and indicating lights, control relays, elapsed time meters, and other devices as shown on the Drawings and required for the applications.
8. The CONTRACTOR shall furnish anchor bolts as required for aligning and mounting the motor control center. Floor channels with end covers shall be of type recommended by the manufacturer and shall be furnished for installation in a concrete pad.
9. The motor control centers shall be furnished with warning signs to notify maintenance personnel of multiple sources of power within the motor control units. Reference Article 430-74 of the NEC.

B. Power

1. The motor control centers shall be supplied from a 480V, 3-phase, 3-wire or 4-wire, (as indicated on the Drawings) 60 Hz power source. The incoming power feeders shall be sized as shown on the Drawings. All terminals for incoming and outgoing power cables shall be provided with compression lugs, solderless connectors.

C. Bus

1. Power shall be distributed by means of a continuous, tin plated copper horizontal bus, rated as shown on the Drawings. The bus shall be braced for 65,000A rms symmetrical (minimum) at 480V. The horizontal bus shall be effectively isolated from all wiring troughs and other working areas. Vertical bus extensions shall be tin plated copper, isolated by rigid, glass-polyester moldings so as to be a separate self-supported assembly. Full height vertical bus shall be installed in all sections including those containing spare units and "prepared" spaces. No extra safety jacks or similar devices shall be required to obtain an essentially dead-front condition. Access shall be provided for inspection and maintenance from the front. Minimum horizontal bus rating shall be 600A. Minimum vertical bus rating shall be 300A.

D. Incoming Line Units

1. Each incoming line unit shall contain buswork and fittings as required with cable lugs for cables of sizes and quantities shown on the Drawings. Cable lugs shall be suitable for their respective conductors.

E. The Unit Compartments

1. Each unit compartment shall be provided with an individual front door hinged to the vertical structure. Each plug-in unit shall be supported and guided by a removable unit support pan, so that the unit rearrangement is easily accomplished. The rearrangement of the unit support pan from one location to the other shall be accomplished without use of tools. After insertion, each plug-in unit shall be held in place by at least one multi-turn latch, located at the front of the unit. The latch shall be located for front accessibility and installation convenience. An additional mechanical interlock shall be provided to prevent withdrawal of the unit from the stationary structure with the operating mechanism in the ON position.
2. The unit plug in power stabs shall be electromagnetically tin plated copper to yield a low resistance connection and designed to tighten during heavy current surges and short circuits. The stab shall be backed by spring steel clips to provide and maintain a high pressure, two point connection to the vertical bus. They shall be free floating and self loading plug-in. Wiring from the unit disconnecting means to the plug-in stab shall be exposed at the rear of the unit. The power cable terminations at the plug-in stab shall be mounted in a two-piece, glass polyester support assembly. This support assembly shall provide a separate isolated pathway for each phase, minimizing the probability of a unit fault condition reaching the power bus system.
3. NEMA Size 1 through Size 5 non-reversing starters shall be plug-in units. Size 1, 2, and 3 shall utilize stab assembly rated 100A. Stab assemblies for Size 4 and Size 5 starters shall be rated for the starters maximum output current rating.
4. An industrial, heavy-duty flange handle mechanism shall be supplied for the control of each disconnecting means. This mechanism shall be engaged with the disconnect device at all times as an integral part of the unit regardless of the unit door position. The operator handles shall have an up-down motion with the down position as off. Horizontally mounted operator handles for feeder circuit breaker units up to 225A are permissible if accepted by the ENGINEER. The ON-OFF condition of the disconnecting means shall be permanently marked on the handle operator. 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.
5. The operator handle of all units shall be interlocked with the door units so that the disconnect means cannot be switched unless the door unit is closed. A means shall be provided for purposely defeating the interlock during maintenance or testing. This interlock shall also prevent opening the unit door unless the disconnecting means is in the off position. An externally operated defeater requiring the use of a screwdriver shall provide access to the unit without interrupting service.
6. The overload relays shall be resettable from the outside of the enclosure by means of an insulated bar or button.

F. Ground Bus

1. The horizontal ground bus shall be tin plated copper and located in the bottom horizontal wireway. The minimum size of the horizontal ground bus shall be 1/4 inch x 1 inch (6.35mm x 25.4mm).
2. A pressure type ground lug(s) shall be mounted on the ground bus in the main circuit breaker section, size, and quantity as required for the termination of system and equipment grounding conductors.
3. The vertical ground bus shall be tin plated copper and solidly connected to the horizontal ground bus. This ground bus, in combination with the unit ground bus stab, establishes unit grounding before the plug-in power stabs engage the power bus, and conversely, as the unit is withdrawn, grounding is maintained until after the plug-in power stabs are disengaged.
4. The vertical load ground bus shall be tin plated copper and solidly connected to the horizontal ground bus. The vertical load ground bus assembly, comprised of the vertical load ground bus and the unit load ground bus connector, shall provide a termination point for the load equipment grounding conductor at the unit. This fixed connection shall not have to be removed when the unit is withdrawn from the motor control center.

G. Isolation and Insulation

1. Horizontal bus access covers and vertical bus covers shall isolate the energized buses to guard against the hazard of accidental contact. These covers shall be molded of a glass polyester material.
2. The horizontal bus shall be isolated from the top horizontal wireway by a grounded steel barrier. This barrier shall be removable to allow access to the bus and connections for maintenance.
3. The vertical bus cover shall provide unit plug-in openings which shall permit unit plug-in stab assemblies to pass through and engage the vertical bus. The unit plug-in openings shall be sized to minimize the probability of inadvertent contact with the vertical bus.
4. Isolation of unused stab openings shall be accomplished by use of a manual shutter to close off the stab opening. These shutters shall be attached to the structure so that when they are removed (to allow a stab connection) they are retained in the structure and are readily accessible for use should a plug-in unit be removed from the motor control center.
5. All units shall be isolated from one another, above and below, by unit support pans or steel barriers, which can remain in place when the units are withdrawn.
6. Incoming line compartments shall be isolated from horizontal and vertical wireways by steel barriers.
7. A molded unit isolating barrier shall be provided to isolate the unit from the vertical wireway.

H. Combination Motor Control Units

1. Motor branch circuits shall be protected by a motor circuit protector (MCP).
2. The motor circuit protector shall be operated by a toggle type handle and shall have a quick make, quick break overcenter switching mechanism that is mechanically trip free from the handle, so that the contacts cannot be held closed against short circuits and abnormal currents. Tripping shall be clearly indicated by the handle automatically assuming a position midway between the manual ON and OFF positions. All latch surfaces shall be ground and polished. All poles shall be so constructed that they open, close, and trip simultaneously.
3. Motor circuit protectors shall be completely enclosed in a molded case. Motor circuit protectors shall have the trip unit sealed to prevent tampering. Ampere ratings shall be clearly visible. Contacts shall be of non-welding silver alloy. Arc extinction must be accomplished by means of arc chutes, consisting of metal grids mounted in an insulating support.
4. Each pole of these motor circuit protectors shall provide instantaneous short circuit protection by means of an adjustable magnetic only element.
5. Motor circuit protectors shall be applied in circuits with available fault currents not exceeding those listed by the control manufacturer for the motor circuit protectors in combination with a contactor and overload relay.
6. Motor circuit protector's ratings, modifications, etc., shall be as specified herein and as indicated on the Drawings.
7. Motor circuit protectors shall be completely enclosed molded case devices with a current sensing coil in each of the 3 poles and have an adjustable magnetic trip setting by means of a single knob on the front. The motor circuit protector shall be manually operable. The protector shall be designed to meet the NEC requirement concerning motor full load and locked-rotor current.
8. The settings of the motor circuit protectors shall be based on the power studies specified in Section 16000, Basic Electrical Requirements, and the motor nameplate data of the motors installed.

I. Motor Starters

1. Motor starters shall conform to NEMA Standard IC1 and shall be for across-the-line starting, unless otherwise indicated. IEC rated equipment is not acceptable and shall be used as a basis for rejection of the equipment. The size of the starter shall be as required for the particular load. Minimum starter size shall be NEMA Size 1. Size 1 and 2 starters shall be completely drawout type, so that units may be withdrawn without disconnecting any wiring. Size 3 and 4 full-voltage, non-reversing starters shall be drawout type after disconnecting power leads only. Starters over three-space units high may be bolt-on type. A positive guidance system shall be provided to assure proper alignment of wedge-shaped power stabs in deadfront openings in vertical power bus.

2. A suitable control disconnect device(s) to comply with the requirements of the NEC shall be provided.
3. Magnetic starters and contactors shall be electromagnetic vertical or horizontal lift design with double break cadmium oxide silver contacts. Design shall meet or exceed the requirements of UL and NEMA Standards. Coils shall be hot molded construction to protect the coils from mechanical and environmental damage.
4. Each starter shall be able to accommodate a minimum of seven auxiliary contacts in addition to the hold-in contact.
5. Each starter shall be supplied with a 3 pole, manual reset overload relay. 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 shall not be used.
6. Each motor starter coil shall be equipped with a surge-suppression device for protection of the solid state equipment (e.g. programmable logic controller) wired as part of the control circuit.
7. Interposing relays with 24 VDC coils shall be furnished for the motor control circuits as specified herein, indicated on the Drawings, and as required. The contact ratings of the relays shall be coordinated with the burden of the motor starter coil. If the burden or other electrical requirements exceed the contact rating of general purpose, plug-in relays, machine tool type relays with adequate contact ratings shall be provided.
8. The minimum control power transformer VA requirements are as follows:

Size 1 and 2	80 VA
Size 3	200 VA
Size 4	250 VA
Size 5	350 VA
9. Additional control power transformer capacity shall be provided when required. The CONTRACTOR and motor control center manufacturer is advised to review the 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.

10. Reduced voltage solid state starters shall be provided for the motor loads as specified herein and as indicated on the Drawings. Starters shall be combination type with molded case motor circuit protector and padlockable handle.
11. Reduced voltage solid state starters shall be used as the motor controller for some motor loads indicated on the Drawings and as bypass starters for other motor loads as specified herein and indicated on the Drawings. The CONTRACTOR shall coordinate the supply of the reduced voltage solid state starter with the starting and running characteristics of its respective motor-driven load to ensure a complete and operable system. Coordination between the motor control manufacturer and the mechanical equipment (e.g. pump, blower, etc.) supplier(s) is essential and required to ensure that speed-torque requirements are met. Specifically, the motor controller shall provide enough voltage at the time of start and produce enough torque to start the load while maintaining the desired results of a reduced voltage start.

J. Circuit Breakers

1. Where specified herein, indicated on the Drawings, or required, the main circuit breaker shall be rated for service entrance and bear a service entrance label.
2. Unless otherwise indicated, circuit breakers shall be manually operable and shall provide thermal-magnetic, inverse-time-limit overload, and instantaneous short-circuit protection.
3. Breakers shall be molded case type, rated 480 VAC, 2 or 3 pole and have 100 ampere or larger frames. The minimum interrupting rating shall be 65,000A rms symmetrical at 480V.
4. Overload protection shall be provided on all poles with trip settings as indicated on the Drawings. Breakers of 225-ampere frames and larger shall have interchangeable trip units and adjustable magnetic trip elements.
5. Time-current characteristic curves and other necessary information and data for each size of breaker furnished shall be provided in the Submittal, if requested by the ENGINEER.
6. Horizontally mounted operator handles for feeder circuit breaker units up to 225A are permissible if accepted by the ENGINEER.

K. Terminal Blocks

1. Terminal blocks shall be mounted within the unit insert and in the front for accessibility. Control terminal blocks shall be pull-apart style as manufactured by the specified motor control center manufacturer, or equal.
2. The pull-apart terminal block assembly shall consist of a male and female component held together with captive screws. The terminal block assembly shall be designed to withstand the effects of vibration, yet able to be pulled apart without difficulty. The terminals of the assembly shall be recessed to isolate them from accidental contact. Terminal markings shall be provided for the purpose of

identifying terminations.

3. For starters of Size 2 and smaller, terminate starter wiring (power and control) and external field wiring on terminal strips provided in each unit.
4. For starters of Size 3 and larger, terminate control wiring and external field control wiring on the terminal strips. Terminal strips shall be as specified herein and shall be:
 - a. Pull-apart type to facilitate wiring connections for disconnecting factory or field conductors.
 - b. Rated to accept conductor sizes as specified and as indicated on the Drawings.
 - c. Rate terminal strips as disconnecting means for foreign interlock voltages.
5. Provide with a minimum of four (4) spare control terminals. Additional control terminals shall be furnished commensurate with the size/space factor of the unit.

L. Pushbuttons, Selectors Switches, Pilot Lights, and Other Pilot Devices

1. Pushbuttons and selector switches shall be of the heavy-duty type, 30.5 mm, rated NEMA A600.
2. All pilot devices shall be rated for NEMA Type 13 applications.
3. Pilot lights shall be the LED type.
4. Pilot devices shall be as manufactured by Eaton Corporation, or other manufacturers specified herein.

M. Nameplates

1. The motor control centers shall be furnished complete with engraved phenolic nameplates for each motor control center and each unit compartment. Equipment names and numbers as indicated on the single line diagrams shall be used as the basis to engrave the nameplates. Nameplates shall be as specified in Section 16195, Electrical-Identification.

N. Future Space Requirements

1. Provide spaces for future combination starter and other units in the motor control centers. Furnish spaces with hardware to accommodate future plug-in control unit without modification of vertical sections. Provide the number of spaces required for future control units as indicated on the Drawings, minimum.
2. Provide additional vertical sections to ensure total number of spaces as indicated on the Drawings. The number of vertical sections is contingent upon specific manufacturer's final proposed and ENGINEER-accepted configuration of motor

control center units.

O. Motor Control Center Additions

1. The CONTRACTOR shall furnish and install complete motor control center sections or individual motor control center units to be added to existing motor control centers in accordance with these Specifications and as indicated on the Drawings.
2. These additions shall be of the same manufacturer, type, rating, and color as the existing motor control centers. Furnish and install all hardware necessary to connect the buses of the new and existing motor control centers, including ground buses. Enclosures shall match existing.

P. Motor Control Center Modifications

1. The CONTRACTOR shall modify existing motor control centers and specific motor control center units as specified herein and indicated on the Drawings. These modifications include, but are not limited to, additions of door mounted pilot devices, modifications to existing motor control circuits and other work.

Q. Metering

1. Each motor control center assembly shall be furnished and installed with a Power Expert 4000 power quality meter with display module as manufactured by Eaton Corporation. A communication expansion card to support Ethernet communication to the plant control system and a 1GB memory card shall be provided with each meter.

R. Surge Protective Devices

1. The motor control centers shall be furnished with integrated Type II surge protective devices (SPD). SPDs shall be provided in the location and quantity as shown on the Drawings.
2. The SPD shall be rated, designed, tested, listed, and labeled in accordance with UL-1449, third edition. Products labeled in accordance with previous editions of UL-1449 are not acceptable.
3. The SPD shall be factory installed by the motor control center manufacturer using a direct bus connection. There shall be no cable connection between the bus bar and the SPD device.
4. The SPD shall have a fault current rating equal to or greater than that of the fault current rating of the motor control center. The SPD shall employ metal-oxide varistor (MOV) technology. If integral fusing is used, the fuses shall allow the maximum rated surge current to pass without fuse operation.
5. The SPD shall have a maximum continuous operating voltage (MCOV) of at least 115% of the nominal voltage of the switchgear. The Voltage Protection Rating (VPR) of the SPD shall be submitted for ENGINEER review.

6. The Nominal Discharge Current (In) of the SPD shall be 20kA, minimum. Peak surge current ratings shall not be used as a basis for applying the SPD to the system.
7. The SPD shall provide ten modes of protection for Wye connected systems, and seven modes of protection for Delta connected systems.
8. The SPD shall be furnished with an audible alarm and silence pushbutton, integral SPD status LEDs (one per phase), and a Form C dry contact for remote indication of alarm. A surge counter shall also be provided.
9. The SPD equipment shall be Clipper Power System by Eaton Corporation.

2.03 REDUCED VOLTAGE SOLID STATE STARTER

- A. The solid-state reduced-voltage starter (RVSS) shall be UL and CSA listed. The solid-state reduced-voltage starter shall be an integrated unit with power SCRs, logic board, an integral paralleling bypass contactor, and electronic overload relay enclosed in a single molded housing. The starter shall meet all applicable requirements of this Section and other sections in this Division.
- B. The RVSS shall be suitable for continuous operation at 115% of its continuous ampere rating. To ensure that pump/motor load starting torque requirements are met, the CONTRACTOR shall furnish the starter of the next higher maximum continuous current rating than otherwise required based on the full load ampere rating of the motor.

The CONTRACTOR is fully responsible for the review of the mechanical specifications to determine specified motor speed, horsepower and full load amperes. This information is available in the applicable mechanical specifications for each piece of equipment (e.g. Blowers).

- C. The RVSS shall be suitable for the following environmental conditions:
 1. Operating Temperature: 0-50 degrees C (ambient temperature)
0-40 degrees C (enclosed)
 2. Humidity: 0-95 percent non-condensing.
 3. Altitude: up to 3,300 feet.
- D. The RVSS shall be suitable for operation on a 480VAC, 3-phase, 60 Hertz system.
- E. The SCR-based power section shall consist of six back-to-back SCRs and shall be rated for a minimum peak inverse voltage rating of 1400 volts PIV. Units using triacs or SCR/diode combinations are not acceptable. Resistor/capacitor snubber networks shall be used to prevent false firing of SCRs due to dv/dt effects.
- F. The integral paralleling run bypass contactor shall energize when the motor reaches full speed and close/open under one times motor current. The paralleling run bypass contactor

shall utilize an intelligent coil controller to limit contact bounce and optimize coil voltage during varying system conditions. The coil shall have a lifetime warranty.

- G. The starter shall be provided with electronic overload protection as standard and shall be based on an inverse time-current algorithm. Overload protection shall be capable of being disabled during ramp start for long acceleration loads. Overload protection shall be adjustable and shall have a motor full load ampere adjustment from 30 to 100% of the maximum continuous ampere rating of the starter. The starter shall have selectable overload class setting of 5, 10, 20 or 30. The starter shall be capable of either an electronic or mechanical reset after a fault. Units using bimetal or eutectic alloy overload relays are not acceptable. Overtemperature protection (on heat sink) shall be standard.
- H. The starter shall provide protection against improper line-side phase rotation as standard. The starter shall stop the motor load if a line-side phase rotation other than A-B-C exists. This feature shall be capable of being disabled.
- I. The starter shall provide protection against a phase loss or unbalance condition as standard. The starter shall stop the motor load if a 50% current differential between any two phases is encountered. This feature may be disabled via a DIP switch on the device keypad.
- J. The starter shall provide protection against a motor stall condition as standard. This feature may be disabled via a DIP switch on the device keypad.
- K. The starter shall provide protection against a motor jam condition as standard. This feature may be disabled via a DIP switch on the device keypad.
- L. The starter shall be provided with a form C normally open (NO), normally closed (NC) contact that shall change state when a fault condition exists. The contacts shall be rated 60 VA (resistive load) and 20 VA (inductive load). In addition, an LED display on the device keypad shall indicate the type of fault (Overtemp, Phase Loss, Jam, Stall, Phase Reversal, and Overload).
- M. The starter shall be provided with an unpowered internal "Run" contact rated for 24VDC or 120 VAC operation.
- N. The following control function adjustments on the device keypad shall be provided:
 - 1. Selectable Torque Ramp Start or Current Limit Start
 - 2. Adjustable Kick Start Time, 0-2 seconds
 - 3. Adjustable Kick Start torque, 0-90%
 - 4. Adjustable Ramp Start Time; 0.5-180 seconds
 - 5. Adjustable Initial Starting Ramp Torque; 0-100%
 - 6. Adjustable Smooth Stop Ramp Time; 0-60 seconds.

The Human Interface Module (HIM) provided for the RVSS shall be the same as provided for the variable frequency drives.

- O. Enclosed units shall include a motor circuit protector (MCP) for short-circuit protection and quick disconnect means. A 120 VAC control power transformer, fused on both the primary and secondary sides, shall be provided for the control power source. Input and output isolation contactors shall be furnished as indicated on the Drawings.
- P. RVSSs integrated into motor control center structures shall meet the enclosure requirements for motor control centers as specified herein.
- Q. The complete starter assembly shall be rated per UL 508D for a withstand rating of 65 kAIC rms. Starters enclosed in motor control centers shall be of the same manufacturer.
- R. The following accessories and spare parts shall be provided for each starter:
 - 1. Surge suppressor mounted on the line side of the starter to clip the input line voltage.
 - 2. Lug kits for both the line and load side of the starter.
 - 3. One user's manual for each frame size of starter.
 - 4. One spare 24VDC power supply for each size used.
- S. The reduced voltage solid state starter shall be the Intelligent Technologies IT with integral bypass as manufactured by Eaton Corporation.

PART 3 -- EXECUTION

3.01 INSTALLATION

- A. The motor control centers shall be installed as shown on the Drawings and in accordance with the manufacturer's installation instructions.
- B. Install motor control centers to allow complete unit door swing required for unit removal. This is specifically required where a vertical section of motor control center is set next to a wall to the left of the motor control center section.
- C. Where motor control center structures are located away from walls to allow bottom conduit entry, the CONTRACTOR shall furnish and install sheet metal coverings for openings along the sides and top of the motor control center line-up. The purpose of the coverings is to minimize dust, dirt, and undesirable materials from collecting behind the equipment. The sheet metal coverings shall be of the same material, gauge, and finish as the motor control center.

3.02 PAINTING

- A. The enclosures shall be cleaned, primed, and finish coated in accordance with the manufacturer's standard process. The pre-treatment process shall be a zinc chromate

primer followed by a "One Coat" paint process that is monitored to meet the manufacturer's specifications for paint color, texture, thickness, and durability. Enclosure interior and exterior finish color shall be ANSI 49 (medium light gray). The color of the back panel/bucket located within the MCC enclosure shall be white.

- B. 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.

3.03 RUBBER MATS

- A. A three foot wide rubber mat shall be furnished and installed on the floor and in front of each motor control center. The mat shall be long enough to cover the full length of each motor control center. The mat shall be 1/4 inch thick with beveled edges, canvas back, solid type with corrugations running the entire length of the mat. The mat shall be guaranteed extra quality, free from cracks, blow holes, or other defects detrimental to their mechanical or electrical strength. The mat shall meet OSHA requirements and the requirements of ANSI/ASTM D-178 J6-7 for Type 2, Class 2 insulating matting.

- END OF SECTION -

SECTION 16495 - VARIABLE FREQUENCY DRIVE SYSTEMS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The CONTRACTOR shall furnish, install, connect, test and place in satisfactory operating condition all variable frequency drives (VFDs) as specified herein and indicated on the Drawings.
- B. Reference Section 16000, Basic Electrical Requirements, Section 16902, Electric Controls and Relays.

1.02 TESTING

- A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 1. The following tests are required:

1. Shop Tests

- a. The VFDs specified in this Section shall be shop tested and inspected in accordance with the equipment manufacturer's standard procedures. The testing and inspection procedures shall demonstrate that the equipment tested conforms to the requirements specified. The VFD manufacturer shall use standard testing procedures for printed circuit board, stand alone VFD assemblies, and configured VFD systems.
- b. Factory test the complete variable frequency drive system in accordance with IEEE and NEMA standards with these Specifications.
- c. Variable frequency drive system components, including power transistors, diodes shall be 100 percent inspected and tested using standard test procedures. Printed circuit boards shall be tested using the VFD manufacturer's standard "run-in" test method.
- d. After the specified inspections and tests have been successfully completed, the variable frequency drive system shall undergo a four (4) hour operational test at 100 percent motor load without an unscheduled shutdown.

2. Certified Shop Tests and Reports

- a. Submit description of proposed testing methods, procedures, and apparatus.
- b. Submit notarized and certified copies of all test reports.
- c. Submit factory bench-test data to indicate that the manufacturer's proposed equipment has been tested in the specified arrangement and found to achieve specified accuracy.

3. Field Tests

- a. Field tests shall be performed in accordance with requirements specified in the General Conditions, Division 1, and Section 16000, Basic Electrical Requirements.
- B. Authorized representatives of the City shall be allowed free access to the shop at all times while work is in progress for the purpose of inspection, witnessing of tests, and obtaining information on the progress of the work. The City shall give the CONTRACTOR 72 hours prior notice.
- C. Acceptance of a shop test does not relieve CONTRACTOR from requirements to meet field installation tests under specified operating conditions, nor does the inspection relieve the CONTRACTOR of responsibilities.
- D. The CONTRACTOR shall successfully complete acceptance test procedures on the assembled drive system that demonstrate compliance with the requirements of this Specification. The test plan shall be submitted for acceptance at least 30 days prior to the planned test date.
- E. Drive system shall not be shipped from the manufacturing and assembly facility until the acceptance tests are completed and the acceptance tests are completed and the results approved by the test representative.
- F. Tests may be witnessed by a representative of the ENGINEER. Variable frequency drive manufacturer shall notify the ENGINEER 2 weeks in advance and shall provide testing procedures to the ENGINEER 4 weeks prior to actual testing. Failure of a test shall result in rejection of the equipment until performance is in compliance with these Specifications.
- G. Certification on materials and records of shop tests necessary for the inspector to verify that the requirements of the Specifications are met, shall be made available to the inspector.
- H. Submit signed and dated certification that all of the factory inspection and testing procedures described herein have been successfully performed by the CONTRACTOR prior to shipment.

1.03 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in General Conditions and Section 01300, Submittals, the CONTRACTOR shall obtain from the equipment manufacturer and submit the following:
 1. Shop Drawings
 2. Harmonic Study Report
 3. Programming Guides/Manuals
 4. Operation and Maintenance Manuals
 5. Spare Parts List

6. Special Tools List
7. Shop Test Plan
8. Reports of Certified Shop and 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. Drawings submitted by the manufacturer shall be complete and documented to provide the City with operations and maintenance capabilities.
- D. Shop drawings for each VFD shall include but not be limited to:
 1. Layout drawings of the variable frequency drive system that include all cabinet or enclosure dimensions, access details, and weights.
 2. Layout drawings of panels or enclosures showing size, arrangement, color, and nameplates. Drawings shall include the physical arrangement of door mounted devices located on the variable frequency drive enclosure. Sufficient detail shall be provided for locating conduit stub-ups. Conduit stub-ups shall be coordinated with the location of integral output load reactors or filters. General "catalog data sheet" layout drawings which are not specific to the systems specified herein are not acceptable.
 3. Custom schematic and interconnection wiring diagrams of all electrical work, including terminal blocks and identification numbers, wire numbers and wire colors. Standard schematics and wiring diagrams that are not custom created by the manufacturer for the variable frequency drives for this project are not acceptable. These drawings shall be circuit specific for each motor-load combination. Indicate all devices, regardless of their physical location, on these diagrams. Specific equipment names consistent with the Drawings shall appear on each respective diagram.
 4. Complete single line diagrams indicating all devices comprising the variable frequency drive system including, but not limited to, circuit breakers, motor circuit protectors, contactors, instrument transformers, meters, relays, timers, control devices, and other equipment comprising the complete system. Electrical ratings of all equipment and devices shall be clearly indicated on these single line diagrams.
 5. Complete Bills of Material and catalog data sheets for all equipment and devices comprising the variable frequency drive system.

6. Confirmation of the spare parts requirements as specified herein.
 7. Documented data regarding output load reactors or filters as specified herein.
 8. Confirmation that one (1) copy of "Drive Executive" software shall be provided as specified herein.
- E. The shop drawing information shall be completed 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.
- F. Prior to completion and final acceptance of the project, the CONTRACTOR shall furnish and install "as-built" wiring diagrams for each VFD and bypass starter. These final drawings shall be plastic laminated and securely placed inside each VFD and starter door and included in the O&M manuals.
- G. Product Data shall include, but not be limited to:
1. Functional diagrams that identify major system functional blocks and interfaces.
 2. Special requirements or restrictions of the motor-load combination that may result from operation on the variable frequency drive system.
- H. Harmonic Study and Data shall include but not be limited to:
1. Report of Harmonic Study to determine the harmonic distortion present in the voltage and current waveforms on motor terminals and in the electrical distribution system(s) caused by the variable frequency drive system as specified herein.
 2. Voltage and current waveforms supplied by variable frequency drive at the motor leads.
 3. Necessary descriptions regarding calculation method, assumptions, values and notations, basis for input information, manufacturer's harmonic content data, and calculation results interpretation.
- I. Programming Guides and Manuals shall be submitted. If the variable frequency drive systems require computer software or configuration, provide copies of all programming guides/manuals. Flow charts and listings of software developed shall be submitted to the ENGINEER. Submit final flow charts and program listings no later than 6 weeks prior to factory testing of the system.
- 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, Section 01300, Submittals and Section 11000, Equipment - General Provisions.

1.06 TOOLS, SUPPLIES, AND SPARE PARTS

- A. The VFDs and accessories shall be furnished with all special tools necessary to disassemble, service, repair, and adjust the equipment. All spare parts as recommended by the equipment manufacturer shall be furnished by the CONTRACTOR to the City.
- B. The CONTRACTOR shall furnish the following spare parts for each VFD:
 - 1. For 60HP and below, supply (1) complete spare VFD for each unique VFD per unique application.
 - 2. For 75HP and above, supply all manufacturer recommended spare parts and quantities.
- C. The 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.
- D. 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 City.
- E. Spare parts lists, included with the shop drawing submittal 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.
- F. 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.

1.07 SERVICES OF MANUFACTURER'S REPRESENTATIVE

- A. The CONTRACTOR shall provide the services of a qualified manufacturer's technical representative who shall adequately supervise the installation and testing of all equipment furnished under this Contract and instruct the CONTRACTOR's personnel and the City's operating personnel in its maintenance and operation as outlined in the General Conditions, Division 1, and Section 11000, Equipment - General Provisions. The services of the manufacturer's representative shall be provided for a period of not less than as follows:
 - 1. One trip of one (1) working day during installation and start-up/configuration of the equipment.
 - 2. One trip of one (1) working day after acceptance of the equipment.
 - 3. One trip of one (1) working day during the warranty period.
- B. Any additional time required to achieve successful installation and operation shall be at the expense of the CONTRACTOR. The manufacturer's representative shall sign in and out at the office of the Resident representative on each day he is at the project.

1.08 IDENTIFICATION

- A. Each VFD 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 VFD. Nameplates shall be as specified in Section 16195, Electrical - Identification.

1.09 TRAINING

- A. The CONTRACTOR shall provide training for City personnel. Training shall be conducted by the manufacturer's factory trained specialists who shall instruct City personnel in operation and maintenance of all equipment provided under this Section. The instruction shall demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of equipment. Such instruction shall be scheduled at a time arranged with the CITY at least 2 weeks in advance of the training and shall be provided while the respective Technical Representative's equipment is fully operational. The CONTRACTOR shall submit an Agenda for approval prior to scheduling. The CONTRACTOR shall have submitted, and had accepted, the O&M Manuals prior to commencement of training. Training shall be provided to four separate shifts of the CITY's personnel between the hours of 6:00 A.M. and 6:00 P.M. as necessary. The CONTRACTOR shall provide professional video recordings of all training sessions. Completed, labeled recordings shall be provided to the CITY for each type of training session.
- B. Provide the services of an experienced, factory trained technician or service ENGINEER of the variable frequency drive manufacturer at the jobsite for minimum total of 3 days for training of City personnel, beginning at a date mutually agreeable to the CONTRACTOR and the City, as outlined above. The technician shall be on duty at the site for at least 8 hours per day and shall be available 24 hours per day when required to advise concerning special problems with equipment and systems.
- C. Include in the bid the training of personnel in the operation and maintenance of each furnished variable frequency drive pump control system. For the purpose of this training section of the Specifications, a system is by definition a group of pumps or equipment which all serve a common function (e.g. Centrifuge Feed Pumps, etc.). Training shall include at least one session for 2 designated employees for each system.

1.10 WARRANTY

- A. CONTRACTOR shall warrant that the material and workmanship of all components and the operation of the variable frequency drive system and auxiliary equipment is in accordance with the latest design practices and meets the requirements of this Specification.
- B. Warranty work shall include, but not be limited to, the following:
 - 1. Replace components found to be faulty and make changes in equipment arrangement or adjustments necessary to meet the equipment or functional requirements or this Specification.
 - 2. Warranty shall include system rewiring and substitution and rebuilt or additional equipment required during trial operation or subsequent operation of the unit during the period of this warranty.

3. Warranty shall be in effect for a period of 24 months following final acceptance of the system.

1.11 CONSTRUCTION SEQUENCING

- A. The CONTRACTOR shall reference Section 01520, Maintenance of Facilities and Sequence of Construction, of these Specifications.

PART 2 -- PRODUCTS

2.01 MANUFACTURERS

- A. The equipment covered by this Specification is intended to be standard equipment of proven performance. 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. Unless otherwise specified herein or indicated on the Drawings, it is the intent of these specifications that the VFDs be provided as part of the motor control center equipment.
- C. The CONTRACTOR shall obtain the VFDs from one manufacturer who shall also manufacture the enclosure and major equipment components. The manufacturer shall have a minimum of five years experience in the manufacture of similar units and shall have a general distribution to the electrical trade. Subcontracting of wiring will not be acceptable.
- D. The VFDs shall be manufactured by Square "D"/ Schneider Electric or Benshaw, per the City's preference.
- E. The VFDs shall be 6 or 18 pulse as indicated on the Drawings.
- F. Motor control circuits shall be wired in accordance with the requirements specified herein or indicated on the Drawings.
- G. Variable frequency drive manufacturer shall be responsible for the successful application and operation of the entire drive and control system serving the motor and driven equipment. This includes the responsibility for obtaining all load, torque, speed and performance requirements from the respective sources and integrating these into a variable frequency drive system that fulfills the requirements of this Specification.
- H. The CONTRACTOR and variable frequency drive system manufacturer are cautioned regarding the review and compliance with the total Contract Documents. Typical examples are circuit breakers, motor circuit protectors, magnetic starters, relays, timers, control and instrumentation products, pilot devices including pushbuttons, selector switches and pilot lights, enclosures, conduit, disconnect switches, terminal boxes, and other equipment.

2.02 PRODUCT REQUIREMENTS

- A. Variable speed drives shall be adjustable frequency, adjustable voltage, pulse width modulated (PWM) design. The units shall be microprocessor controlled, fully digitally

programmable, and capable of precise and repeatable speed regulation of three phase 480 volt AC NEMA Design B induction motors. Variable frequency drives for other than NEMA Design B induction motors (e.g. NEMA Design C) shall be coordinated with the requirements of that respective load.

Drive units shall perform continuous self diagnostics as well as load and drive self check on startup.

- B. All drives shall have permanently mounted programming and display modules. These modules shall provide programming access to all drive parameters, display all fault codes to assist with diagnostics and provide a display of output speed in percent or load.
- C. This specification describes variable speed motor control which includes the design, fabrication, testing, installation and support requirements for variable frequency drive systems for 3-phase, squirrel cage rotor, induction motors driving pumps or other equipment. In addition to the variable frequency drive system, provide a motor controller for bypass starting during variable frequency drive downtime, where specified herein and indicated on the Drawings.
- D. Each variable frequency drive to be a complete alternating current electric drive system including hardware, software, technical data, and spare parts necessary to accomplish variable speed operation of an induction motor and load combination in accordance with the requirements as indicated on the Drawings and as described in these Specifications.
- E. Variable frequency drive system manufacturer shall be responsible for the design and performance of the entire drive system and shall either manufacture all items of equipment or supply them using coordinated specifications furnished to the original equipment manufacturers to insure compatibility and performance in accordance with this Specification. Variable frequency drive manufacturer shall coordinate with suppliers of the drive motors and driven equipment. Motors shall be as specified in Section 16040 and other specific equipment Sections of the Specifications.
- F. Variable frequency drive system shall be suitable for operation as part of a 480 VAC, 3-phase, 60 Hertz power distribution system. The complete variable frequency drive system shall withstand the mechanical forces exerted during short circuit conditions when connected directly to a power source having available fault current of 65,000 amperes symmetrical at rated voltage.
- G. The variable frequency drive system shall be suitable to operate, at times, on a limited power source engine-generator set. The system shall be provided with equipment and devices to prevent waveform distortion as specified herein.
- H. Provide control and sequence logic as specified herein and indicated on the Drawings. Control and sequence logic shall be designed such that the motor-load combination can be operated in the manual mode upon control and sequence logic failure, including all necessary personnel and equipment safety interlocks.
- I. Design each variable frequency drive motor drive speed control system so that through simple programming by either factory engineers or City's trained operating personnel, specific control and protection functions can be attained.

2.03 DESIGN REQUIREMENTS

- A. Each variable frequency drive system shall meet the requirements of this Specification without derating any of the induction motor operating parameters including service factor and nameplate horsepower. The variable frequency drive system manufacturer shall specifically identify special requirements or restrictions of the motor-load combination that may result from operation on the variable frequency drive system.
- B. The variable frequency drive shall consist of a 6 or 18 pulse diode semiconductor rectifier system, direct current link, and pulse width modulated inverter. The inverter shall invert the direct current voltage into an alternating current voltage at a frequency which shall be proportional to the desired speed. This alternating current voltage and frequency shall both vary simultaneously at a constant "Volts-Per-Hertz" ratio to operate the induction motor at the desired speed.
- C. Variable frequency drive shall operate from fixed frequency power supply and convert this input power into variable speed induction motor shaft power as required by this Specification. Provide each variable frequency drive with a motor circuit protector as indicated on the Drawings which shall be padlockable. Provide each variable frequency drive with 5% line reactors at the input. Include the necessary drive controllers and output contactors to accomplish the intended control of the variable frequency drive system.
- D. The drive shall operate the motor and produce full rated nameplate horsepower at the motor output shaft without exceeding motor nameplate full load current and with the motor not exceeding rated total temperature not including the additional temperature increment that constitutes the motor service factor. Motor shall retain its service factor when operated by the variable frequency drive.
- E. The overall drive system efficiency shall be a minimum of 95 percent when operating the specified motor-load combination at rated voltage, frequency, and current.

This efficiency shall be calculated as follows:

$$\text{Efficiency (\%)} = \frac{\text{Power (Load)}}{\text{Power (Supply)}} \times 100$$

- F. Power (Load) is the total 3-phase power delivered to the motor, measured at the output terminals of the drive system, including output filters or transformers. Power (Supply) is the total electrical power delivered to the drive system, measured at the input terminals of the variable frequency drive including input filters, line reactors, isolation transformers, or other harmonic distortion suppression equipment. Include power input required for auxiliary equipment (e.g., controls, fans, air conditioning, pumps) for complete system operating in this Power (Supply) total.
- G. Variable frequency drive shall provide smooth, stepless changes in motor speed and acceleration over the entire operating speed range from minimum to maximum speed (revolutions per minute). The variable frequency drive shall be provided with maximum and minimum frequency limits.

- H. Variable frequency drive system to maintain a desired output frequency (setpoint) with a steady state accuracy of 0.5 percent of rated frequency of 60 Hertz for a 24 hour period.
- I. Variable frequency drive to have an automatic current limit feature to control motor currents during startup and provide a "soft start" torque profile for the motor-load combination. The variable frequency drive shall also limit current due to motor winding or motor lead phase-to-phase short circuit or phase-to-ground short circuit. The current limit protection setting shall be field adjustable.

Variable frequency drive shall be furnished with programmable electronic overload and torque limits.

- J. Drive system shall achieve a desired output frequency (setpoint) with a repeatability of 0.1 percent of rated frequency of 60 Hertz.
- K. Drive system to be capable of operating the specified load continuously at any speed within the operating speed range of 10 percent to 100 percent of rated speed. The minimum and maximum continuous operating speeds shall each be adjustable within this speed range. The variable frequency drive shall provide for field adjustment of these setpoints.
- L. Drive system controls to be microprocessor-based and have controlled linear acceleration capability to ramp up the speed, revolutions per minute, of the motor-load combination from the minimum selected operating speed to the maximum selected operating speed in a minimum of 30 seconds. Provide two field-adjustable speed setpoints for the variable frequency drive to skip equipment resonant frequencies. Provide controlled linear deceleration capability. The acceleration and deceleration time limits shall be field adjustable to values up to 120 seconds.
- M. Voltage or current unbalance between phases of the variable frequency drive output voltage shall not exceed five percent of the instantaneous values. The variable frequency drive system shall continuously monitor the output voltages and generate an alarm condition when the unbalance exceeds 3 percent. The system shall detect and generate a separate alarm for loss of any output phase voltage (single phasing). Phase unbalance shall be as defined by NEMA Standard MG-1.
- N. Variable frequency drive system to operate continuously without interruption of service or damage to equipment during transient input voltage variations of plus or minus 10 percent for a duration of 15 cycles. Unacceptable voltage fluctuations on the supply bus shall cause under or overvoltage protection to trip and remove supply voltage from the drive system. Variable frequency drive output voltage regulation shall be plus or minus 2 percent.
- O. The CONTRACTOR shall size variable frequency drive system and components to provide, indefinitely, motor load current equal to 125 percent of the motor nameplate full load current.

The CONTRACTOR is fully responsible for the review of the mechanical specifications to determine specified motor speed, horsepower and full load amperes. This information is available in the applicable mechanical specifications for each pump, drive, conveyor, blower, etc. Reference the Table of Contents.

- P. The audible noise (sound pressure) level of a motor when operated from no load to full load with the variable frequency drive described herein shall not increase more than 5 decibels

(dbA), at 5 feet in any direction from the motor, above its noise level when operated from a utility power source without the variable frequency drive.

- Q. Variable frequency drives shall be provided with output reactors or filters to prevent elevated voltage levels at the motor terminals. These devices shall be located as recommended by the VFD manufacturer and shall be provided in electrical enclosures suitable for the application and process environment.

If the VFD manufacturer can provide documented data in Shop Drawings that shows output load reactors or filters not required to mitigate reflected wave as a concern, then output load reactors or filters will not be required. However, any related problems in the field shall be corrected at the VFD manufacturer's expense.

2.04 OPERATING CONDITIONS

- A. The following operating conditions are applicable for all equipment of this Specification.

1. Humidity: 0-95 percent (ambient temperature).
2. Ambient Temperature: 0-50 degrees Celsius (ambient temperature).
0-40 degrees Celsius (enclosed).
3. Altitude: up to 3,300 feet
4. Power Supply: 480 volts, 3-phase, 60 Hertz.
5. Available Short Circuit Duty: as specified herein.

2.05 SYSTEM FEATURES AND CHARACTERISTICS

- A. A Human Interface Module (HIM) shall be furnished to provide controls and indicators to accomplish operation and maintenance functions as specified herein and indicated on the Drawings. The HIM provided for the VFDs shall be the same as provided for the reduced voltage solid state starters. As a minimum, each VFD shall provide indication of the following:

1. Digital Speed Indicator: Revolutions per minute (input from tachometer).
2. Variable Frequency Drive Mode Indicator: Red; as required.
3. Bypass Mode Indicator: Red; as required.
4. Input Voltage
5. Output Voltage
6. Output Current
7. Output Frequency
8. Output Speed: 0-100%

9. Drive Ready Indicator: White
10. Run Indicator: Red.
11. Stop Indicator: Green.
12. Enclosure Overtemperature.
13. Alarm Indicator: Amber.
14. Alarm Read-out: Display.

B. Each VFD shall provide the following minimum automatic and manual control functions:

1. Hand-Off-Auto Selector Switch (as required)
2. Start and Stop Push Buttons (as required)
3. VFD-Bypass Selector Switch (as required)
4. Local-Auto Speed Control Selector Switch (as required)
5. Local Speed Increase/Decrease
6. Alarm Reset Push Button
7. 24VDC Coil Pilot Relay for Remote Run Command
8. Alarm auxiliary contacts and other devices as indicated on the Drawings and specified.
9. Provision for a run permissive from other equipment when the VFD is in "Auto"

C. Each VFD shall provide "potential-free" output contacts for the following conditions:

1. Drive running.
2. Drive in "Remote" and all trip conditions cleared.

Pilot devices shall be as specified in Section 16902, Electrical Controls and Relays.

- D. Variable frequency drive system shall provide a 4-20 mADC output signal that is proportional to the drive output frequency for use as speed feedback or control and remote speed indication.
- E. Variable frequency drive system shall accept an input command signal to control the output frequency in the automatic and/or manual control modes as specified herein or indicated on the Drawings. The system shall accept the input increase/decrease command with a resolution that permits incremental changes in speed, revolutions per minute, equal to or less than 0.1 percent of rated speed.

- F. When operating in the automatic mode, the variable frequency drive system shall shut down during a power outage. Upon restoration of normal power and after an adjustable time delay (0-2 minutes; motor has coasted to zero speed and there is no backspin), the variable frequency drive system shall automatically restart and then ramp up to speed as required by the control system. The process operator shall not be required to reset the system manually after a shutdown caused by a power outage.
- G. Variable frequency drive shall be furnished with a multiple attempt restart feature.
- H. Furnish a door mounted device or function for those variable frequency drives where an additional speed reference signal (e.g., from a remote potentiometer, an analog output from a setpoint (PID) controller, an analog output from the plant control system, or similar analog signal) is to be supplied to the variable frequency drive in addition to the door mounted manual speed control.
- I. Provide a motor circuit protector with shunt trip coil and current-limiting fuses for each variable frequency drive. Provide each variable frequency drive with its respective drive controller for each motor.
- J. Include in each variable frequency drive system an automatic trip feature which will remove the drive output from the motor and allow it to decelerate safely. This automatic system shall trip and indicate the fault only upon the following conditions:
 - 1. Output voltage unbalance (trip threshold field set).
 - 2. Open phase.
 - 3. Motor overload.
 - 4. Motor stator winding fault (phase-to-ground, phase-to-phase).
 - 5. Loss of input power to the variable frequency drive or unacceptable voltage variation.
 - 6. High variable frequency drive equipment temperature.
 - 7. Variable frequency drive system failure as determined by the manufacturer.
 - 8. Component failure.
 - 9. Overcurrent.
 - 10. Undercurrent.
- K. Provide variable frequency drive system with transmitted and received radio interference protection. In addition, provide protection against starting a rotating motor, both directions (coasting to zero speed and backspin). In the event that a motor automatic restart feature (catch the motor "on-the-fly") is provided in the drive controller as standard, this feature shall be capable of being disabled.

- L. Variable frequency drive design shall include on-line diagnostics, with an automatic self-check feature that will detect a variable frequency drive failure which in turn affects motor operation and generates an alarm contact output rated for 125 VDC suitable for interfacing with the control system.
 - 1. Diagnostics shall operate a visual alarm indicator that is visible on the variable frequency drive equipment cabinets without opening the cabinet doors.
 - 2. Diagnostics shall provide an easily readable output that will isolate a failure.
 - 3. Provide an easily accessible fault buffer (up to 16 faults in FIFO status). These faults shall be capable of being monitored and extracted by a PLC over the network. The VFD manufacturer shall provide one (1) copy of "Drive Executive" software to extract any fault buffer information.
 - 4. Provide a normally open dry contact for each alarm function to enable remote indication.

2.06 ENCLOSURES

- A. Unless otherwise specified or indicated on the Drawings, the variable frequency drive enclosures shall be NEMA 1A (gasketed), force ventilated, dead-front, with front accessibility. VFDs integrated into motor control center structures shall meet the enclosure requirements for MCCs as specified in Section 16482, Motor Control Centers. Furnish enclosures for both bottom and top entry of cables. The location of integral output load reactors or filters shall not interfere with the location of bottom entry cables. Furnish variable frequency drive systems so that rear cabinet access is not required for operations, maintenance, and repair tasks. Other enclosure requirements are:
 - 1. The enclosures shall be cleaned, primed, and finish coated in accordance with the manufacturer's standard process. The pre-treatment process shall be a zinc chromate primer followed by a "One Coat" paint process that is monitored to meet the manufacturer's specifications for paint color, texture, thickness, and durability. Enclosure interior and exterior finish color shall be ANSI 49 (medium light gray). The color of the back panel located within the VFD enclosure shall be white.
 - 2. Industrial use enclosures shall be as manufactured by Hoffman, Rittal, or equal.
- B. Furnish each variable frequency drive system with the control and indication devices as specified herein and as indicated on the Drawings. Furnish main circuit breakers with an external operating handle interlocked with the door so that the door cannot be opened unless the disconnect is in the OFF position. Power supply to the motor from both the variable frequency drive and bypass starter shall be capable of being positively locked in the OFF position. The disconnect shall be interlocked so that equipment cannot be energized when the door is open.
- C. Electrical bus, including ground bus, shall be tin-plated copper. Power and control wiring shall be copper, color coded and identified in accordance with these Specifications.
- D. Equipment shall be of modular construction allowing normal maintenance and repair to be done with ordinary hand tools. Design and install power electronic component assemblies so that, where practicable, components can be individually removed and replaced.

2.07 HARMONIC DISTORTION SUPPRESSION

- A. A comprehensive pre-equipment-selection harmonic study shall be prepared by the CONTRACTOR. The results of this pre-equipment selection study shall be submitted to the ENGINEER as part of the submittals specified herein. Should this study indicate the need for tuned filters, line reactors, isolation transformers, or other harmonic distortion suppression equipment, these shall be supplied at no additional cost to the City. Indicate the location of the harmonic suppression equipment in the submittal data. Location is subject to acceptance by the ENGINEER.
- B. The harmonic distortion values resulting from operation of all or any variable frequency drive-driven motor-load combinations operating at full load shall be as defined in IEEE Standard 519.
 - 1. Maximum allowable total harmonic voltage distortion (THD): 5 percent of the fundamental.
 - 2. Maximum allowable individual frequency harmonic voltage distortion: within the limits of IEEE standard 519.
 - 3. Maximum allowable total demand distortion (TDD): within the limits of IEEE Standard 519-1992, Table 10.3.
 - 4. Maximum allowable individual frequency harmonic demand distortion: within the limits of IEEE Standard 519-1992, Table 10.3.
 - 5. The harmonic distortion levels shall be specific to the "Point of Common Coupling" (PCC) as defined in IEEE Standard 519. Unless otherwise indicated on the Drawings, the PCC shall be at the primary terminals of the step down transformer serving the main low voltage distribution equipment that supplies the VFDs.
- C. System single line diagrams and field access to the plant site will be provided to the CONTRACTOR for the purpose of providing this study. CONTRACTOR shall obtain from others other information that may be necessary to perform this study. Input data and other pertinent information used in harmonic study shall be coordinated by the CONTRACTOR with the following:
 - 1. Input data/information/results of the short circuit fault analysis specified herein.
 - 2. Electrical system configuration and electrical equipment shop drawing submittal data including, but not being limited to new non-linear loads, new linear loads, and new capacitors.
- D. Preparation of this pre-equipment selection study does not relieve the requirement for the CONTRACTOR to perform and submit the results of a second, final comprehensive study prepared by a recognized independent authority acceptable to the City after equipment installation.

- E. In addition, the CONTRACTOR shall field measure actual harmonic distortion and verify with tests performed by an independent authority acceptable to the City after satisfactory full-load operation.
- F. As part of the specified harmonic studies and other work for this project, identify and correct resonance conditions in the electrical distribution system at no additional cost to the City. Shop drawings, data, location of the respective equipment and its connection to the electrical distribution system shall be acceptable to the ENGINEER.
- G. Reference Section 16000, Basic Electrical Requirements for information gained from the electric utility company during the design period which could be used for the purpose of the harmonic study. Inclusion of this information, however, does not relieve the CONTRACTOR nor his suppliers of the responsibility of obtaining all the necessary information required to perform the harmonic study.

2.08 MISCELLANEOUS

- A. Encapsulate critical components in ceramic or metal.
- B. Auxiliaries, including fans, that are required for rated load operation at maximum ambient temperature, shall be 100 percent redundant. A new and unused spare replacement fan(s) or air conditioning unit(s), shipped in original carton, may be acceptable.
- C. Circuit boards and electrical components shall meet the corrosion protection requirements specified in these Specifications. Varnished or epoxy encapsulated circuit boards and tropicalized contactors suitable for corrosive environments shall be furnished where the VFDs are not located in climate controlled areas.

PART 3 -- EXECUTION

3.01 INSTALLATION

- A. The VFDs shall be installed as shown on the Drawings and in accordance with the manufacturer's installation instructions.
- B. Install VFDs to allow complete door swing required for component removal. This is specifically required where a VFD is set in the corner of a room.
- C. Include in the bid an allowance for factory-trained service personnel, other than sales representatives, to supervise field installation, inspect, make final adjustments and operational checks, make functional checks of spare parts, and prepare a final report for record purposes. Adjust control and instrument equipment until this equipment has been field tested by the CONTRACTOR and the results of these tests have been accepted by the ENGINEER.

3.02 PAINTING

- A. 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 coating as used for factory finishing coats.

3.03 RUBBER MATS

- A. A three foot wide rubber mat shall be furnished and installed on the floor and in front of each VFD assembly. The mat shall be long enough to cover the full length of each VFD system. The mat shall be 1/4 inch thick with beveled edges, canvas back, solid type with corrugations running the entire length of the mat. The mat shall be guaranteed extra quality, free from cracks, blow holes or other defects detrimental to their mechanical or electrical strength. The mat shall meet OSHA requirements and the requirements of ANSI/ASTM D-178 J6-7 for Type 2, Class 2 insulating matting.

- END OF SECTION -

SECTION 16902 - 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. Motor control circuits shall be wired in accordance with the requirements specified herein or indicated on the Drawings.
- D. Reference Section 16000, Basic Electrical Requirements, Section 16195, Electrical Identification, and Section 16160 – Cabinets and Enclosures.
- E. The CONTRACTOR shall furnish and install, as specified herein and indicated on the Drawings, all motor control components and wiring for all motor-operated equipment furnished under this Section and all other Sections as indicated. The CONTRACTOR shall review the entire Contract Drawings to be totally familiar with his responsibilities.
- F. The CONTRACTOR shall furnish and install all external power and control wiring to control panels of prewired packaged equipment, unless indicated otherwise.
- G. Control wiring requirements are indicated in electrical schematics and descriptions on the Drawings, in functional control descriptions which appear in Section 11420 of these Specifications, and in equipment manufacturer's equipment data. The CONTRACTOR shall furnish and install all control wiring in accordance with these Contract Documents. The CONTRACTOR shall provide all control circuits and wiring for a particular item of equipment in accordance with requirements as set forth by the manufacturer of the particular item of equipment.
- H. As specified herein and indicated on the Drawings, furnish and install instrumentation wiring and connections to instrumentation equipment furnished under all Contracts of this Specification. Unless indicated otherwise, motor control switches, pilot lights, relays, and other control equipment for mounting in instrumentation panels shall be furnished, installed, and wired by the CONTRACTOR.
- I. Where pumps provided by others are furnished with solenoid valves or other devices for control, the CONTRACTOR shall wire these valves or devices.
- J. Unless otherwise specified herein or indicated on the Drawings, motor controllers shall be wired to drop out and remain dropped out on loss of power to the line side of the controller. Operator action shall be required to restart the motor unless the motor is intended to automatically restart.

- K. Motor control components and control wiring shall conform to NEMA Specifications ICS, Industrial Controls and Systems.
- L. Where devices are installed on the doors of NEMA 4, 4X, or 3R enclosures, devices shall be selected and installed to maintain the NEMA rating of the enclosure.
- M. Wiring in all starters, panels, junction boxes, and similar equipment shall be brought out to numbered terminal strips for interconnection. The CONTRACTOR shall be responsible for documenting terminal numbers for all starters, controls, panels, and similar equipment provided under the Contract. At the completion of the project, the CONTRACTOR shall submit a complete set of record drawings showing and/or listing all terminals in boxes, panels, starters, and similar equipment in a single, complete bound package for the equipment and control supplied under the Contract. Reference the General Conditions, Section 01300 - Submittals and Section 01700 - Project Closeout.
- N. The CONTRACTOR is responsible for coordinating the electrical work under the Contract with all equipment starters, controls, and instruments provided by others. The CONTRACTOR shall verify and coordinate with process equipment power supply and voltage, process equipment control power supply and voltage, and details of installation and interconnection. Coordination shall include distribution of approved electrical shop drawings to the General Contractor's equipment suppliers.
- O. Electrical control schematic diagrams drawn using a ladder-type format in accordance with JIC standards shall be submitted for all electrical equipment which is being provided under the Contract.
- P. Record drawings shall be provided in accordance with requirements in the General Conditions, Section 01300 - Submittals, and Section 01700 - Project Closeout. One complete set of record wiring diagrams encased in plastic or plexiglass envelopes shall be provided for each starter, panel, and similar equipment. The diagrams shall include wire color codes showing connections from numbered terminal blocks to external equipment.
- Q. Where space or strip heaters are provided within the enclosures for electrical equipment, the CONTRACTOR shall make connections to these heaters from an appropriate power source and operate the heaters with temperature control as necessary until the equipment is installed and operated according to its intended use.
- R. Control stations shall be furnished and installed at each motor and at all other controlled devices (e.g. solenoid valves) as specified herein and indicated on the Drawings.

1.02 TESTING

- A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 1. The following tests are required:
 - 1. Witnessed Shop Tests
 - a. None required.
 - 2. Field Tests

- a. Field tests shall be performed in accordance with the requirements specified in the General Conditions, Division I, and Section 16000, Basic Electrical Requirements.

1.03 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01300, Submittals, the CONTRACTOR shall obtain from the equipment manufacturer and submit the following:
 - 1. Shop Drawings.
 - 2. 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. The letter and performance affidavit described above must be included in the first submittal.
- 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 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 1.

1.06 TOOLS, SUPPLIES AND SPARE PARTS

- A. The electrical control and relay systems and accessories shall be furnished with all special tools necessary to disassemble, service, repair, and adjust the equipment. All spare parts as recommended by the equipment manufacturer shall be furnished to the City by the CONTRACTOR.
- B. The 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.

- C. 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 City.
- D. Spare parts lists, included with the shop drawing submittal, 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.
- E. Parts shall be completely identified with a numerical system to facilitate parts 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 part number.

PART 2 -- PRODUCTS

2.01 CONTROL COMPONENTS

- A. Pushbuttons (PB) and selector switches (SS) shall be Type E34 as manufactured by Cutler-Hammer, Type 3SBO as manufactured by Siemens Energy and Automation Inc., General Electric Company Type CR104P, the Allen-Bradley Company equivalent, or The Square D Company equivalent. Pushbuttons and selector switches shall be 30.5 mm, heavy-duty, oil tight NEMA 4X corrosion resistant with 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. Pushbuttons and selector switches shall be non-illuminated. Pushbuttons shall include a full guard. Panic stop/alarm pushbuttons shall be red mushroom type with manual-pull release.
- B. Pushbuttons and selector switches for all electrical equipment shall be of the same type and manufacturer unless otherwise specified herein or indicated on the Drawings.
- C. Pushbuttons, selector switches, and other pilot devices for pump control panels shall be as specified herein and in the functional control descriptions which appear in Section 17950, and as shown on the Drawings.
- D. Engraved nameplates shall be securely fastened to the front of each pushbutton station, disconnect switch, and motor starter remotely located from the motor control center. If adequate space is not available, the nameplate shall be mounted below the push button station. Nameplates shall be as specified in Section 16195, Electrical Identification. Identify all switches, control stations, and motor controllers as to their respective equipment.
- E. Pilot lights shall be Type E34 as manufactured by Cutler- Hammer, Type 3SBO as manufactured by Siemens Energy and Automation Inc., General Electric Company Type CR104P, the Allen-Bradley Company equivalent, The Square D Company equivalent, or equal. Pilot lights shall be of the proper control voltage, LED type, push to test, heavy-duty, corrosion-resistant NEMA 4X with 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. Pilot light lens colors shall be as follows:

Red	-	"Run", "On", "Open"
Green	-	"Off", "Closed"

Amber - "Alarm", "Fail"
White - "Control Power On"

- F. Pilot lights for all electrical panels shall be of the same type and manufacturer unless otherwise specified herein or indicated on the Drawings.
- G. Pilot lights for pump control panels shall be round with custom engraved legend plates for each pilot light.
- H. Control Relays (CR) shall be Type D3 as manufactured by Cutler-Hammer, Type CR420 as manufactured by General Electric Company, Potter-Brumfield equivalent, the Allen-Bradley Company equivalent, The Square D Company equivalent, or Siemens Energy and Automation Inc. equivalent. Relays shall be general purpose plug-in type with coil voltage as shown on the Drawings and sealed 10 ampere contacts. All relays shall have three SPDT contacts rated 120/240 VAC and 28 VDC minimum. Machine tool relays shall be provided when the contact burden exceeds 10 amperes. Miniature type or "ice cube" relays are not acceptable.
- I. Timing Relays (TR) shall be the general purpose plug-in type, Type TR as manufactured by Cutler-Hammer, Type TUC as manufactured by Diversified Electronics, the Allen-Bradley Company equivalent, The Square D Company equivalent, or Siemens Energy and Automation Inc. equivalent. Timing relays shall be electronic type with 120 VAC coils unless otherwise specified or indicated on the Drawings. Timers shall be provided with two SPDT timed output contacts. Contact ratings shall be the same as for control relays as specified above.
- J. Control Stations (CS) shall be as manufactured by Cutler-Hammer, General Electric Company, the Allen-Bradley Company equivalent, The Square D Company equivalent, or Siemens Energy and Automation Inc. equivalent. Control stations shall be furnished and installed complete with pushbuttons, selector switches, and other pilot devices as specified herein or indicated on the Drawings. Stop pushbuttons shall be furnished with a lock-out device as specified herein and indicated on the Drawings.

Control station enclosures shall be cast aluminum with gasketed cover for all indoor dry areas. Control station enclosures shall be NEMA 4X aluminum with gasketed cover for all indoor damp/wet process areas or NEMA 7 for classified areas. Control station enclosures shall be NEMA 4X aluminum with gasketed cover for all outdoor applications.

Control stations located in hazardous locations shall be suitable for the Class, Division, and Group to suit the application. The pilot devices shall be the factory sealed type mounted in enclosures as specified above.

- K. Open type motor 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 able to withstand 20 million operations. Each starter shall be furnished with a minimum of two spare auxiliary contacts in addition to the hold-in contact.

The motor starters shall conform to NEMA Standard IC1 and shall be for across-the-line starting, unless otherwise indicated. IEC rated equipment is not acceptable and shall be used as a basis for rejection of the equipment.

Starters shall be furnished with manual reset overload relays in each phase sized in accordance with the NEC. Provide door mounted overload reset button with metal (not plastic) shaft. Starters shall be provided with coils for 120 VAC operation, unless otherwise indicated on the Drawings.

Ambient compensated, thermal, bi-metallic type overload relays shall be furnished and installed providing Class 20 operation. Overload relays shall be equipped with one additional normally open (NO) and normally closed (NC) isolated contact for use as specified herein or indicated on the Drawings. Solid state overload relays shall only be furnished and installed if specifically accepted by the ENGINEER. The CONTRACTOR shall furnish and install correctly sized overload heaters based on the rating of the motor installed.

Open type magnetic motor starters shall be Cutler-Hammer Type AN16 or AN56 using NEMA rated Freedom Series contactors, General Electric Company equivalents, the Allen-Bradley Company equivalent, The Square D Company equivalents, or Siemens Energy and Automation Inc. equivalents.

- L. Selected motors are indicted as requiring elapsed time indicators. Provide Eagle Signal Type HK210A6, General Time Catalog #ED27NR, or Allen-Bradley equivalent elapsed time indicators for 120 VAC volt operation mounted flush in the respective motor starter compartment door. Where clearance is not obtainable for compartment door closing, mount timers in a separately mounted enclosure, with each timer nameplated. Wire elapsed time indicator to operate when the respective motor operates.
- M. Terminal blocks shall be assembled on non-current carrying galvanized steel DIN mounting rails securely bolted to the enclosure or cabinet subpanel. Terminals shall be tubular screw type with pressure plate for wire size #22 - #8 AWG.

Power terminal blocks shall be single tier with a minimum rating of 600 volts, 30A. Signal terminal blocks shall be single tier with a minimum rating of 600 volts, 20A. Separate terminal strips shall be provided for each type of power and signal used within each cabinet. There shall be a sufficient quantity of terminals for the termination of all spare field conductors.

Terminals shall be marked with a permanent, continuous marking strip. 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. Subject to the approval of the ENGINEER, a vendor's pre-engineered and prefabricated wiring termination system may be acceptable.

The terminal blocks shall be as manufactured by Phoenix Contact, Inc., Allen-Bradley, Wieland, Inc., The Square D Company, or equal.

- N. Alarm horns shall be as manufactured by Federal Signal Corporation, Edwards Signaling Company, EST (Edwards Systems Tech), or equal. Alarm horns shall be made for surface, flush, or semi-flush mounting on walls, panels, enclosures, or on square outlet boxes. Alarm horn sound output level shall be of 100 dB (nominal) at 10 feet.

PART 3 -- EXECUTION

3.01 CONFIGURATION OF CONTROLS AND EQUIPMENT

- A. All controls including wiring, control switches, pushbuttons, indicating lights, control interlocks and similar devices, shall be provided at the control voltages specified herein or indicated on the Drawings. Each motor starter shall be provided with a control power transformer mounted in the starter unit. Primary wiring to the control power transformer shall be tapped to two (2) poles on the load side of the circuit breaker or fusible switch. Both primary wires shall be fused with 10- ampere, slow-blow fuses. The fuse on the ungrounded secondary side shall be capable of handling 100 percent to 125 percent of the rated control transformer secondary current. Control power transformers shall be provided with volt-ampere (VA) ratings equal to a minimum of 125 percent of the volt-ampere (VA) load connected to the transformer.
- B. All equipment, cabinets, and devices furnished under the Contract 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 which are currently in production. All equipment provided shall be of modular construction and shall be capable of field expansion.
- C. All equipment shall be designed to operate on a 60 Hz alternating current power source at a nominal 117 volts, plus or minus 10 percent, except where specifically noted. All regulators and power supplies required for compliance with the above shall be provided.
- D. All switches shall have double-pole, double-throw, contacts rated at a minimum of 600 VA, unless specifically noted otherwise.
- E. Materials and equipment used shall bear a U.L. label wherever such labeling of equipment and materials are available.
- F. Unless otherwise specified or indicated on the Drawings, all equipment shall be designed, furnished, and installed so that in the event of a power interruption, the equipment must be restarted manually after a power failure.
- G. All power terminals shall be insulated and identified.
- H. All instruments shall operate at 10 to 125 degrees F unless otherwise specified.
- I. Internal wiring within all starters, panels, instruments, junction boxes and similar equipment, shall be brought out to numbered terminal strips for interconnection and field wiring.
- J. 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. All internal components shall be identified with suitable plastic or metal engraved tags attached with drive pins adjacent to (not on) each component identifying the component in accordance with the Drawings, Specifications, and supplier's data.

- K. The functional control descriptions which appear in Section 11420 indicate interconnections between panels, instruments, and similar equipment. Unless otherwise noted, the CONTRACTOR shall provide all interconnecting wiring and conduit for complete control systems. The CONTRACTOR shall make all connections to equipment devices, instruments, and all components requiring electrical connection.
- L. The shield on each instrumentation cable shall be continuous from source to destination and shall be grounded as directed by the manufacturer of the instrumentation equipment. In no case shall more than one ground point be employed for each shield. The ground point shall be as specified in Division 17. All analog control functions shall utilize 4-20 mA DC control signals, unless otherwise specified. All analog transmission shall take place within shielded twisted cables which are not susceptible to interference or noise.
- M. Lightning/surge protection shall be provided to protect the instrumentation and control system from induced surges propagating along the signal and power supply lines. The protection systems shall be such that the protective level shall not interfere with normal operation, but shall be lower than the instrument surge withstand level, and shall be maintenance free and self-restoring. Equipment shall be housed in a suitable metallic case, properly grounded. Ground wires for all surge protectors shall be connected to a good earth ground and, where practical, each ground wire run individually and insulated from each other. These protectors shall be mounted within the enclosure or in a separate NEMA 4 junction box coupled to the enclosure.
- N. Reference Division 17 - Control and Information Systems for additional information regarding lightning/surge protection requirements.

3.02 FIELD TESTS

- A. The CONTRACTOR shall conduct field tests prior to operation of the equipment. The ENGINEER shall witness all field testing. Field testing shall be conducted at a time approved by the ENGINEER. Field tests shall be conducted for all hardware components and shall include a functional check of all items. Field tests shall include a functional check of all instruments and control equipment. All equipment shall be connected and fully operational for field testing. Field tests shall demonstrate that the controls perform according to the Contract requirements and that all equipment, valves, switches, controls, alarms, interlocks, indicating lights, and similar equipment function properly. Based on the results of field tests, the CONTRACTOR shall make any required corrections to equipment and controls and shall make any adjustments required to the control logic and control settings to achieve the specified operation or operation otherwise directed by the ENGINEER. Field tests shall be conducted for the full range of operating modes and conditions specified and as directed by the ENGINEER. The CONTRACTOR shall make modifications and adjustments to the controls as directed by the ENGINEER for optimizing operation of the overall system. All costs in connection with field tests of equipment provided under the Contract, shall be borne by the CONTRACTOR. The CONTRACTOR shall be fully responsible for the proper operation of all motor starters and controls during the tests.

- END OF SECTION -

DIVISION 17 – INSTRUMENTATION

SECTION 17000 - CONTROL AND INFORMATION SYSTEM SCOPE AND GENERAL REQUIREMENTS

PART 1 -- GENERAL

1.01 SCOPE

- A. The Contractor shall provide, through the services of an instrumentation and control system subcontractor, all components, system installation services, as well as all required and specified ancillary services in connection with the Instrumentation, Control and Information System. The System includes all 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 as shown and/or specified. The system shall include all measuring elements, signal converters, transmitters, local control panels, digital hardware and software, signal and data transmission systems, interconnecting wiring and such accessories as shown, specified, and/or required to provide the functions indicated.
- B. 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 field panels and associated appurtenances as required.
 - 4. Connect all process instrumentation, motorized valve actuators and variable frequency drive systems to the existing PLC cabinets. This work shall include all required coordination of control voltages, interposing relay operation, sync/source arrangements of 4-20 mA analog circuits, grounding, and termination of instrumentation control wiring. All I/O points shall be tested and demonstrated to be fully functional from the SCADA HMI screens.
 - 5. Full functionality of the existing RAS pump Remote Manual and Remote Automatic control strategy shall be restored prior to RAS Pump Station No. 1 startup. The operators shall have the ability to run the pumps in remote automatic or remote manual from the SCADA HMI. Any minor PLC-7 logic modifications, minor SCADA HMI modifications or PLC-7 wiring modifications required to restore full remote manual and remote automatic control from SCADA shall be provided. Refer to Section 17300 for additional requirements.
 - 6. Provide troubleshooting and minor modifications for the existing PLC logic and SCADA HMI graphics as required to provide full Remote Manual control of each valve actuator from the SCADA HMI. Minor modifications shall include troubleshooting of control and status signals between the PLC/SCADA and valve

actuators, modifications to the mapping of SCADA HMI tags with PLC-I/O, PLC I/O scaling or similar modifications as required. If available, the existing Remote Automatic control strategy for each valve shall be enabled, tested and confirmed to be working. Coordinate with the CITY's ICE department to obtain the latest PLC cabinet drawings and I/O list to determine the assigned PLC I/O terminals for the valve actuator signals. The required I/O points for the valves are listed in the Section 17920 I/O Schedule. Refer to Section 17300 for additional requirements.

- a. PLC-7 (RAS Pump Station No. 1): MOV-64010 and MOV-64012 (Modulating). See Drawing I-2.
 - b. PLC-7 (RAS Pump Station No. 1): PV-64205 (Modulating). See Drawing I-2.
 - c. PLC-8 (RAS Pump Station No. 2): MOV-64013 and MOV-64015 (Modulating). See I/O List 17920.
 - d. PLC-9 (RAS Pump Station No. 3): MOV-23010 (Modulating). See I/O List 17920.
 - e. PLC-15 (RAS Pump Station No. 4): MOV-24010 (Modulating). See I/O List 17920.
 - f. PLC-10 (Main Control Building): MOV-24424 and MOV-24414 (Modulating). See I/O List 17920.
7. Furnish and install new magnetic flow meters. Provide instrument stands and sunshields as required. Refer to Section 17910 "Instrument Schedule" and Section 17701 for requirements.
 8. Replace all existing analog input signal surge suppressors in PLC-7, PLC-8, PLC-9, PLC-10 and PLC-15 with the analog input signal surge suppressors specified in Section 17560. All analog inputs signal shall be tested and verified to be working properly from the existing SCADA HMI screen.
 9. Furnish and install digital control system hardware and software as specified in Division 17.
 10. Final instrumentation and control wiring terminations, at both ends of each cable, shall be performed by the instrumentation and control system contractor. All instrumentation and control conduit and wiring shall be furnished and installed by the electrical subcontractor as required by Division 16.
 11. Furnish, install and terminate all manufacturer supplied instrument cables. Adhere to instrument manufacturer installation requirements and recommendations. Magmeter cables shall be shortened per manufacturer recommendations at the transmitter side of the instrument cable. Long, loose coils of magmeter instrument cable is not acceptable.
 12. Furnish and install surge protection devices for all digital equipment, local control panels, and instrumentation provided under this Division, including connections to grounding system(s) provided under Division 16.
 13. Coordinate grounding requirements with the electrical subcontractor for all digital equipment, local control panels and instrumentation provided under this Division. Terminate grounding system cables at all equipment provided under this Division.

14. Provide system testing, calibration, training and startup services as specified herein and as required to make all systems fully operational.

C. 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.

B. Additional and related work performed under Division 16 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 all equipment, control panels and accessories furnished under Division 17.
2. Conduit and raceways for all instrumentation and control system signal wiring, and grounding systems.
3. Instrumentation and control system signal wiring.
4. Furnish and install grounding systems for all digital equipment, local control panels, and instrumentation provided under Division 17. Grounding systems shall be complete to the equipment provided under Division 17, ready for termination by the instrumentation subcontractor.
5. Termination of all instrumentation and control system signal wiring at all equipment furnished under other divisions of the Specifications.
6. 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 all 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 all signals, and furnishing all 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 all 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 and/or systems and shall provide for the services of a qualified installation engineer to supervise all 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 any system component.
- E. Control system inputs and outputs are listed in the Input/Output Schedule. 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 man/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 all equipment, panels, instrumentation, controls and appurtenances either existing or furnished under other Divisions of the Specifications to determine all requirements to interface same with the control and information system. The Contractor shall coordinate the completion of any required modifications with the associated supplier of the item furnished.
- G. The instrumentation subcontractor shall review and approve the size and routing of all 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 all 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 CITY shall have the right of access to the subcontractor's facility and the facilities of his equipment suppliers to inspect materials and parts; witness inspections, tests and work in progress; and examine applicable design documents, records and certifications during any stage of design, fabrication and tests. The instrumentation subcontractor and his

equipment suppliers shall furnish office space, supplies and services required for these surveillance activities.

- K. The terms "Instrumentation", "Instrumentation and Control System", and "Instrumentation, Control and Information System" shall hereinafter be defined as all 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 and wastewater treatment facilities. 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 and/or models of major hardware or software products (PLC, HMI software, LAN, 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 completion and final payment has been made. Any instrumentation and control system subcontractor that has been subject to litigation or the assessment of liquidated damages for nonperformance on any project within the last five calendar years shall not be acceptable.
- B. Acceptable instrumentation and control system subcontractors shall be CC Control Corporation or Curry Controls Company.

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:

$$A = 100 \times (\text{MTBF} / (\text{MTBF} + \text{MTTR})) \text{ Percent}$$

The availability of a device or system provided with an automatically switched backup device or system shall be determined by the following formula:

$$A = A_2 + 1 - ((1 - A_1) \times (1 - A_1))$$

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:

A	-	Availability
ADC	-	Analog to Digital Converter
AI	-	Analog Input
AO	-	Analog Output
AVAIL	-	Available
BCD	-	Binary Coded Decimal
CSMA/CD	-	Carrier Sense Multiple Access/Collision Detect
CPU	-	Central Processing Unit
CRC	-	Cyclic Redundancy Check
CRT	-	Cathode Ray Tube
CS	-	Control Strategy
DAC	-	Digital to Analog Converter
DBMS	-	Data Base Management System
DI	-	Discrete Input
DMA	-	Direct Memory Access
DO	-	Discrete Output
DPDT	-	Double Pole, Double Throw
DVE	-	Digital to Video Electronics
EPROM	-	Erasable, Programmable Read Only Memory
FDM	-	Frequency Division Multiplexing
FSK	-	Frequency Shift Keyed

HMI	-	Human Machine Interface (Software)
I/O	-	Input/Output
LAN	-	Local Area Network
LDFW	-	Lead-Follow
MCC	-	Motor Control Center
MTBF	-	Mean Time Between Failures
MTTR	-	Mean Time To Repair
OS	-	Operating System
PAC	-	Programmable Automation Controller
PCB	-	Printed Circuit Board
PID	-	Proportional Integral and Derivative Control
PLC	-	Programmable Logic Controller
PROM	-	Programmable Read Only Memory
RAM	-	Random Access Memory
RDY	-	Ready
RMSS	-	Root Mean Square Summation
RNG	-	Running
ROM	-	Read Only Memory
RTU	-	Remote Telemetry Unit
SPDT	-	Single Pole, Double Throw
ST/SP	-	Start/Stop
TDM	-	Time Division Multiplexing
UPS	-	Uninterruptible Power Supply

- H. To minimize the number of characters in words used in textual descriptions on CRT 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 (i.e., for 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

2.01 NAMEPLATES

- A. All items of equipment listed in the instrument schedule, control panels, and all items of digital hardware 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 the equipment identification number and description. 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.
- C. Nameplates shall be attached to metal equipment by 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 stainless steel wire.

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 as outlined below.
- 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.

<u>Task Completed</u>	<u>Maximum Cumulative % Request for Payment</u>
Mobilization	5%
Approved Submittals	20%
Hardware Purchase (excludes field instruments)	40%
Loop Checkout	60%
Control System Start-up and Test	75%
Final System Acceptance Test	90%
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 acceptance 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 all soiled surfaces of installed equipment and materials.
- B. Upon completion of the instrumentation and control work, the Contractor shall remove all surplus materials, rubbish, and debris that has accumulated during the construction work. The entire area shall be left neat, clean, and acceptable to the CITY.

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 all specified control system training requirements.
 - 4. Completion of all punch-list items that are significant in the opinion of the Engineer.
- B. Final acceptance of the System shall mark the beginning of the extended warranty period.

- END OF SECTION -

SECTION 17030 - CONTROL AND INFORMATION 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 Conditions and Division 1 of the Specifications. All submittal material shall be complete, legible, and reproducible, and shall apply specifically to this project.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 01300 – Submittals
- B. Section 17000 – Control and Information System Scope and General Requirements

1.03 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.

1.04 SOFTWARE SUBMITTALS

A. Control Strategies

1. Provide control strategy documentation that includes control strategy diagrams (block oriented logic and ladder logic diagrams, as appropriate) to describe the control of all processes. The written description shall follow the format of the functional control descriptions contained herein. The control strategy submittals shall contain the following as a minimum:
 - a. An overall description of the program structure and how it will meet the specified control requirements.
 - b. A listing of the program.
 - c. Extensive comments in the listings to describe program steps.
 - d. Equation and ladder program derivations for all specified control routines.
 - e. Resource (processor and memory) requirements.
 - f. A listing of inputs and outputs to the control strategy.

B. 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 VBASIC and C programs, and any other add-in custom software.

C. Graphic Displays

1. Submit all graphic displays required to perform the control and operator interface functions specified herein.
2. Submit graphic displays for review by the CITY and the Engineer at least 30 days prior to system startup.
3. The Contractor shall allow for one cycle of revisions to the displays prior to system startup. A cycle of revisions shall be defined as all revisions necessary to complete a single set of changes marked by the Engineer. Additional corrections shall be performed during start-up as required to accommodate changes required by actual field conditions, at no additional cost to the CITY.

4. Two of the required submittals in each revision cycle shall be full color prints of the entire set of SCADA HMI displays modified or created under this contract. Additional sets may be in black-and-white or gray-scale.
5. Displays shall be printouts of actual process graphics implemented in the system.

1.05 CONTROL PANEL SUBMITTALS

- A. For all modifications to the existing PLC-7 panel, submit diagrams showing power, signal, and control wiring, including surge protection, relays, courtesy receptacles, lighting, wire size and color coding, etc.

1.06 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.

1.07 OPERATION AND MAINTENANCE MANUALS

- A. The Contractor shall deliver equipment operation and maintenance manuals in compliance with Section 01300 - Submittals. 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 nonsoftware 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.

1.08 FINAL SYSTEM DOCUMENTATION

- A. All documentation shall be delivered to the CITY 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. If any documentation or other technical information submitted is considered proprietary, such information shall be designated. Documentation or technical information which is designated as being proprietary will be used only for the construction, operation, or maintenance of the System and, to the extent permitted by law, will not be published or otherwise disclosed.
- C. Provide a complete set of detailed electrical interconnection diagrams required to define all revisions to the instrumentation and control system. All diagrams shall be 11 X 17-inch original reproducible prints. All diagrams shall be corrected so as to describe final "as-built" hardware configurations and to reflect the system configuration and control methodology adopted to achieve final system acceptance.
- D. Provide system software documentation for the operation and maintenance of all system software programs modified 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.
- E. Provide application software documentation that contains program descriptions for the operation, modification, and maintenance of all application programs modified for the digital system.
- F. Provide control strategy documentation which shall include control strategy (block oriented or ladder logic) diagrams to describe the control of all processes modified under this Contract. 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.
- G. O&M documentation shall be amended with all final, adjusted values for all setpoints and other operating parameters for CITY reference.
- H. The CITY 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 CITY within 30 days of identifying and solving the problem.

1.11 PROGRAMS AND SOURCE LISTINGS

- A. Provide one copy of source listings on DVD media for all custom software 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.

1.12 SUBMITTAL/DOCUMENTATION FORMAT

- A. All drawing-type submittals and documentation shall be rendered and submitted in the latest version of AutoCAD.
- 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).

1.13 ELECTRONIC O&M MANUALS

- A. Subject to acceptance by the CITY and Engineer, the O&M information may be submitted in part or in whole in an electronic format on optical media.
- B. Electronic O&M manuals shall contain information in standard formats (Searchable Adobe PDF, Word, AutoCAD, HTML, etc.) and shall be easily accessible through the use of standard, "off-the-shelf" software such as an Internet browser.

PART 2 -- PRODUCTS

(NOT USED)

PART 3 -- EXECUTION

(NOT USED)

- END OF SECTION -

SECTION 17040 – CONTROL AND INFORMATION SYSTEM TRAINING REQUIREMENTS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. To familiarize the CITY'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 17000 – Control and Information System Scope and General Requirements

1.03 SUBMITTALS

- A. A minimum of 30 days prior to beginning training, submit a detailed training plan describing the following:
 - 1. Course content.
 - 2. Applicability of each course to management, operations, maintenance, laboratory, etc., personnel.
 - 3. Course schedules.
 - 4. 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 CITY'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. 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 CITY's personnel. No additional compensation will be awarded to the Contractor for training at non-standard hours.

- C. All training courses shall complement the experience and skill levels of the CITY's personnel.
- D. 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.
- E. 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 CITY's personnel passively observe as the instructor demonstrates system functions shall not be acceptable.
- F. Unless otherwise specified, all training courses shall be conducted in the CITY's facilities.
- G. All training shall be completed prior to system acceptance.
- H. Standard manufacturer training courses are acceptable pending approval by the Engineer and CITY.

1.05 SCADA SYSTEM SUPERVISOR TRAINING

- A. One two-hour session for up to 2 SCADA system supervisors each shall be conducted to provide instruction in the use of the WWTP SCADA System to monitor and control the equipment associated with PLC-7. The training shall include, at a minimum:
 - 1. Detailed discussion of the PLC-7 physical modifications, including all wiring modifications.
 - 2. Detailed discussion of the updated PLC-7 PLC logic.
 - 3. Detailed discussion of the WWTP SCADA HMI screen modifications.
 - 4. Detailed explanation of the status and alarm signals displayed on the WWTP SCADA HMI.
 - 5. Detailed explanation of RAS pump operation.
 - 6. Detailed explanation of WAS control valve operation.

1.06 MAINTENANCE PERSONEL AND OPERATOR TRAINING

- A. One two-hour session for up to 8 persons each shall be conducted to provide instruction in the use of the WWTP SCADA System to monitor and control the equipment associated with PLC-7. The training shall include, at a minimum:
 - 1. Overview of the PLC-7 physical modifications, including all wiring modifications.
 - 2. Overview of the updated PLC-7 PLC logic.
 - 3. Overview of the WWTP SCADA HMI screen modifications.
 - 4. Detailed explanation of the RAS Pump Station status and alarm signals displayed on the WWTP SCADA HMI.
 - 5. Detailed explanation of RAS pump operation.
 - 6. Detailed explanation of WAS control valve operation.
 - 7. Detailed explanation installation, operation, and maintenance requirements for all field instrumentation.
- B. 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.

PART 2 -- PRODUCTS

(NOT USED)

PART 3 -- EXECUTION

(NOT USED)

- END OF SECTION -

SECTION 17060 - 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, and the instrumentation subcontractor.
- C. Analog signals shall be signals for transmitting process variables, etc. from instruments and to and from panels, equipment PLC's and Control System PLC's.
- D. Discrete signals shall consist of contact closures or powered signals for transmitting status/alarm information and control commands between starters, panels, equipment PLC's, 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 volts D.C.
- 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/or 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 shall be converted to an isolated, linear, 4-20 milliamperes 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 PLC's, from field devices, starters, panels, etc., shall be unpowered (dry) contacts in the field device or equipment, powered from the PLC's, 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 PLC's to field devices, starters, panels, etc., shall be 24 VDC powered (sourced) from PLC's.
- 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

2.01 PILOT RELAYS

- A. Pilot relays shall be supplied with the following:
 - 1. 24 VDC or 120 VAC coils, as required.
 - 2. At a minimum, DPDT contacts rated at 5 A, 120 VAC or 28 VDC.
 - 3. Sockets for 24 VDC and 120 VAC relays shall be of different configurations.
 - 4. Clips for attachment to sockets.
 - 5. Indicator lights that glow when the relay coil is powered.
- B. Pilot relays shall be as manufactured by Square D, Allen Bradley, Potter & Brumfield, or equal.

PART 3 -- EXECUTION

(NOT USED)

- END OF SECTION -

SECTION 17070 – CONTROL AND INFORMATION SYSTEM TESTING - GENERAL

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 17000 – Control and Information System Scope and General Requirements
- B. Section 17072 – Field Testing
- C. Section 17073 – 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 CITY'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.

PART 2 -- PRODUCTS

(NOT USED)

PART 3 -- EXECUTION

(NOT USED)

- END OF SECTION -

SECTION 17072 – 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 17000 – Control and Information System Scope and General Requirements
- B. Section 17070 – Control and Information System Testing, General
- C. Section 17073 – Final Acceptance Test

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 Sections 17600 and 17700.
 - 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.
- 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.

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 VFD's, 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 DAC's 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 ADC's 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 (at least two when loop checkout is being performed).

PART 2 -- PRODUCTS

(NOT USED)

PART 3 -- EXECUTION

(NOT USED)

- END OF SECTION -

SECTION 17073 – 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 17000 – Control and Information System Scope and General Requirements
- B. Section 17070 – Control and Information System Testing, General
- C. Section 17072 – 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 CITY 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 PLC that is not automatically backed-up shall be considered a system failure if the downtime of the failed controller exceeds one (1) hour.
 - 3. 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.
 - 4. 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)
- 5. Total shutdown of a single PLC resulting from a software fault shall be considered a system failure.
- 6. An erroneous command to the process that can be specifically related to a software fault shall be considered as one (1) hour of downtime.
- 7. The inoperability of any subsystem resulting from a software fault shall be considered a system failure.
- 8. 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 17080 – QUALITY ASSURANCE

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. It is the intent of these Specifications and Drawings to secure high quality in all 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, 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 will be accepted for each type of product.
- C. All equipment shall be designed for the service intended and shall be of rugged construction, of ample strength for all 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.

1.05 OPTIONAL EQUIPMENT

- A. Optional or substituted equipment or both requiring changes in details or dimensions required to maintain all structural, mechanical, electrical, control, operating, maintenance or design features incorporated in these Specifications and Drawings shall be made at no additional cost to the CITY. In the event that the changes are necessary, calculations and drawings showing the proposed revisions shall be submitted for approval. The Contractor shall coordinate all changes with other affected trades and contracts and pay all additional charges incurred.

1.06 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 1 of the Specifications. Maintenance personnel provided by the instrumentation subcontractor shall instruct the CITY's personnel in the operation, adjustment, calibration and repair of the equipment being serviced. All preventive and corrective activities shall be documented with service reports, which shall identify the equipment being serviced, state the condition of the equipment, describe all work performed and list materials used. A copy of all service reports shall be delivered to the CITY 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 1 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 all other equipment. The hardware service technician(s) shall be available on-site within 24 working hours after notification by the CITY.
 - 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 CITY. Corrective software maintenance shall include the supply, installation and startup of all 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 CITY.

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 CITY 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 and/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 CITY 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.
- 1.07 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 all 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.
- 1.08 FABRICATION
- A. Fabrication of all 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.

1.09 INSTALLATION

- A. All 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 all on-site instrumentation and control system construction work from commencement of construction through completion and final acceptance.
- C. All 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. All equipment and materials shall fit properly in their installations. Any required work to correct improperly fit installations shall be performed at no additional expense to the CITY.
- E. All work shall be performed in a neat and workmanlike manner. All 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. All wiring shall be neatly bundled, run in wireway, and terminated. All spare wiring shall be neatly coiled and clearly labeled at both ends for future use by the CITY. Any work not meeting these requirements shall be corrected at no expense to the CITY.
- F. Sufficient common-mode and differential-mode noise rejection shall be provided to insure operation of the plant process control system to meet all specification requirements. General practice 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. All splices in instrumentation and control system signal and network 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:

<u>CIRCUIT VOLTAGE (VAC)</u>	<u>MINIMUM SPACING (IN.)</u>
120	12
240	18
480	18
2000 and above	24

- 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, MCC's, control rooms and all structural and/or 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.

PART 2 -- PRODUCTS

(NOT USED)

PART 3 -- EXECUTION

(NOT USED)

- END OF SECTION -

SECTION 17300 – MISCELLANEOUS MODIFICATIONS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The CONTRACTOR shall furnish, test, install and place in satisfactory operation the miscellaneous modifications described herein together with all programming work, spare parts, accessories, and appurtenances as specified herein or required for a complete and operating system.
- B. All hardware, software, programming, testing and startup services together with all necessary accessories such as power supplies, conditioning equipment, mounting hardware, signal input and output terminal blocks, and plug strips which may be required to complete the work shall be provided.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 17000 - Control and Information System Scope and General Requirements
- B. Section 17500 – Enclosures, General
- C. Section 17560 - Transient Voltage Surge Suppression Devices
- D. Refer to Division 16 for additional requirements for cable, circuit breakers, disconnect switches, etc.

1.03 GENERAL INFORMATION AND DESCRIPTION

- A. These Specifications are intended to give a general description of what is required, but do not cover all details which will vary in accordance with the requirements of the equipment furnished. They are, however, intended to cover the furnishing, delivery and complete installation and field testing, of all materials, equipment and appurtenances for complete systems herein specified, whether specifically mentioned in the Specification or not.
- B. For all units there shall be furnished and installed all necessary and desirable accessory equipment and auxiliaries whether specifically mentioned in these Specifications or not. This installation shall incorporate the highest standards for the type of service shown on the Drawings including field testing of the entire installation and instruction of operating personnel in the care, operation, and maintenance of all equipment.
- C. All equipment shall be of first-class work quality and shall be entirely designed and suitable for the intended services. All materials used in fabricating the equipment shall be new and undamaged.
- D. All equipment of each type, i.e., all controllers, all indicators, all relays, all surge protectors, all signal converters, etc., provided under this Contract shall be furnished by a single manufacturer.

- E. Due consideration shall be given to installation requirements for enclosures in new and existing structures. The CONTRACTOR shall examine plans and/or field inspect new and existing structures as required to determine installation requirements and shall coordinate the installation of all enclosures with the COUNTY 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).

PART 2 -- PRODUCTS

2.01 WWTP SCADA HMI Modifications

- A. As of August 2019, the existing WWTP SCADA HMI software platform is Proficy HMI/SCADA - iFIX Version 5.5 (build 8120) and PLC configuration software is Modicon Unity Pro.
- B. The WWTPs existing SCADA HMI faceplates and PLC logic for the RAS control valves, WAS control valves and RAS pumps shown on the Drawings and described herein shall remain. Provide requisite PLC logic and HMI screens modifications as required to provide the control, status and alarm signals shown on the P&ID Drawings, listed in Section 17920, and as required for a complete and functional installation. Requisite PLC logic and HMI screens modifications shall include:
 - a. opening and viewing the PLC logic program for troubleshooting of control and status signals between the PLC/SCADA and the VFDs, valve actuators and field instruments;
 - b. correcting any discrepancies in the mapping of SCADA HMI tags with PLC-I/O;
 - c. select spare digital inputs and assign PLC I/O addresses to the existing valve control logic in the PLCs.
 - d. SCADA HMI analog value scaling;
 - e. minor changes to HMI graphic text;
 - f. PLC analog I/O scaling, including, but not limited to magnetic flow meter 4-20mA flow signal scaling.
 - g. configuration of new PLC I/O modules or similar modifications.
- C. It is the responsibility of the Instrumentation subcontractor to coordinate with the CITY prior to bidding to visit the plant to review the current I/O lists, PLC cabinet drawings and evaluate existing control panels in the field. The I&C subcontractor shall determine the existing PLC I/O points that can be reused, unless otherwise indicated in Section 17920. For any new PLC I/O points (not existing and assigned) either spare PLC I/O points shall be utilized, or new PLC I/O modules shall be installed in the PLC cabinets to provide additional I/O. Any terminal blocks, DIN rail, fuses, surge suppressors or wiring shall be furnished and installed as required to provide the I/O points listed in Section 17920 or as shown on the Instrumentation Drawings. At final completion of the contract a minimum of one of each type of I/O point (AI, AO, DI, DO) in each PLC cabinet shall be available as a spare that is prewired to a terminal block and ready to accept field wiring (and signal surge suppressor for analog inputs).
- D. The instrumentation subcontractor shall notify the Engineer and the CITY 30 days prior to performing SCADA HMI modifications and take steps to ensure minimal disruption of WWTP operations.

2.02 PLC Control Panel Modifications

- A. **PLC-7 Control Panel Modifications** - Furnish, install and configure a new 8 point analog output module in the empty slot of the existing PLC-7 chassis and replace the unused digital input module in slot 6 with a new 16 point analog input module and wire two of the inputs to terminal blocks and provide AI surge suppressors. Hand the digital input card over to the CITY for use as a spare. For the analog and digital I/O in Section 17920 use the assigned I/O points. For MOV-64012 Position Command select an AO from the new analog output module and assign to the valve actuator function block in the existing PLC-7 logic program. Provide new DIN rail, fused terminal blocks, cabinet internal wiring and terminate all field wiring inside the cabinet as required for a complete working system. Provide surge suppressors that meet or exceed the requirements of Section 17560 for all digital and analog signal terminations from field equipment provided under this contract, including but not limited to all digital and analog signals for MOV-64012, MOV-64010, PV-64205 and FI-64410. Verify that all signals work from the SCADA HMI. Replace **all existing** analog signal surge suppressors in the cabinet with the signal surge suppressors specified in Section 17560.
- B. **PLC-8 Control Panel Modifications** - Furnish, install and configure a new 16-point, 4-20mA analog input module in one of the spare slots in the existing PLC-8 chassis, wire two of the inputs to terminal blocks and provide AI surge suppressors (for use as spares). For the analog outputs and inputs listed in Section 17920 reuse assigned AIs and AOs. For the digital (discrete) inputs listed in Section 17920 select spare digital inputs and assign to the valve actuator function block in the existing PLC-8 logic program. Provide new DIN rail, fused terminal blocks, cabinet internal wiring and terminate all field wiring inside the cabinet as required for a complete working system. Provide surge suppressors that meet or exceed the requirements of Section 17560 for all signal terminations from field equipment provided under this contract, including but not limited to the digital and analog signals for MOV-64013 and MOV-64015. Replace **all existing** analog signal surge suppressors in the cabinet with the signal surge suppressors specified in Section 17560. Verify that all signals work from the SCADA HMI.
- C. **PLC-9 Control Panel Modifications** - For the analog and digital I/O points listed in Section 17920 for MOV-23010 and PV-64207 coordinate assigned I/O with CITY or select and assign spare I/O to the valve actuator function block in the existing PLC-9 logic program. Provide new DIN rail, fused terminal blocks, cabinet internal wiring and terminate all field wiring inside the cabinet as required for a complete working system. Provide surge suppressors that meet or exceed the requirements of Section 17560 for all signal terminations from field equipment provided under this contract, including but not limited to the digital and analog signals for MOV-23010, PV-64207 and FIT-64412. Replace **all existing** analog signal surge suppressors in the cabinet with the signal surge suppressors specified in Section 17560.
- D. **PLC-10 Control Panel Modifications** - Furnish, install and configure a new 16-point, 4-20mA analog input module in one of the spare slots in the existing PLC-10 chassis, wire two of the inputs to terminal blocks and provide AI surge suppressors (for use as spares). For the analog inputs and digital inputs listed in Section 17920 for MOV-24414 and MOV-24424 coordinate assigned I/O with CITY or select and assign spare I/O to the valve actuator function block in the existing PLC-10 logic program. Provide new DIN rail, fused terminal blocks, cabinet internal wiring and terminate all field wiring inside the cabinet as

required for a complete working system. Provide surge suppressors that meet or exceed the requirements of Section 17560 for all signal terminations from field equipment provided under this contract, including but not limited to the digital and analog signals for MOV-24424 and MOV-24414. Replace **all existing** analog signal surge suppressors in the cabinet with the signal surge suppressors specified in Section 17560.

- E. **PLC-15 Control Panel Modifications** - For the digital I/O points listed in Section 17920 for PV-65207 coordinate assigned I/O with CITY or select and assign spare I/O to the valve actuator function block in the existing PLC-15 logic program. For the analog and digital I/O points listed in Section 17920 for MOV-24010 coordinate assigned I/O with CITY or select and assign spare I/O to the valve actuator function block in the existing PLC-15 logic program. Provide new DIN rail, fused terminal blocks, cabinet internal wiring and terminate all field wiring inside the cabinet as required for a complete working system. Provide surge suppressors that meet or exceed the requirements of Section 17560 for all signal terminations from field equipment provided under this contract, including but not limited to the digital and analog signals for MOV-24010, PV-65207 and FIT-65412.

2.03 Documentation

- A. Coordinate with the CITY's ICE Department to receive the latest I/O list and latest control panel electrical schematics prior to providing shop drawing submittals for the modifications described herein. Provide updated control panel schematics for all panels modified in both AutoCAD and .PDF format and submit a minimum of 60 days prior to any startup activities. The CITY's I/O list shall be updated and provided to the CITY prior to final completion of the project.
- B. Instrumentation subcontractor shall submit any PLC program modifications to the Engineer and CITY's ICE Department no less than 30 days prior to the startup period.
- C. CITY shall provide all available existing PLC-7, PLC-8, PLC-9, PLC-10 and PLC-15 documentation to the instrumentation subcontractor upon request.

PART 3 -- EXECUTION

3.01 INSTALLATION

- A. Refer to Section 17000.

- END OF SECTION -

SECTION 17500 – ENCLOSURES, GENERAL

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 as specified herein and as shown on the Drawings.
- B. 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.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 17000 – Control and Information System Scope and General Requirements
- B. Section 17560 – Surge Protection Devices
- C. Section 17600 – Unpowered Instruments, General
- D. Section 17700 – Powered Instruments, General
- E. Refer to Division 16 for additional requirements for cable, circuit breakers, disconnect switches, etc.

1.03 GENERAL INFORMATION AND DESCRIPTION

- 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. Either manufacturer-standard or custom cabinetry may be furnished subject to the requirements of the Contract Documents and favorable review by the CITY.
- C. Due consideration shall be given to installation requirements for enclosures in new and existing structures. The Contractor shall examine plans and/or field inspect new and existing structures as required to determine installation requirements, and shall coordinate the installation of all enclosures with the CITY 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).

PART 2 -- PRODUCTS

2.01 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, 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.

PART 3 -- EXECUTION

3.01 FABRICATION

- A. 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.
- B. 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.
- C. 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.
- D. 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 16 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.
- E. 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.
- F. 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. Care shall be taken to separate electronic signal, discrete signal, and power wiring.
- G. Spare field wiring shall be bundled, tied, and labeled as specified above, and shall be neatly coiled in the bottom of the cabinet.

H. 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 16123 - Building Wire and Cable. Field wiring terminating in panels shall be labeled in accordance with the requirements of Section 16123. Where applicable, the wire number shall be the ID number listed in the input/output schedules.

I. Wires shall be color coded as follows:

Equipment Ground - GREEN

120 VAC Power - BLACK

120 VAC Power Neutral - WHITE

120 VAC Control (Internally Powered) - RED

120 VAC Control (Externally Powered) - YELLOW

24 VAC Control - ORANGE

DC Power (+) - RED

DC Power (-) - BLACK

DC Control - BLUE

Analog Signal – BLACK/WHITE or BLACK/RED

J. 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.

K. 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 INSTALLATION

A. Refer to Section 17000 for additional requirements.

- END OF SECTION -

SECTION 17520 – FIELD PANELS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, test, install and place in satisfactory operation the field panels, with all spare parts, accessories, and appurtenances as specified or shown.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 17000 – Control and Information System Scope and General Requirements
- B. Section 17500 – Enclosures, General

PART 2 -- PRODUCTS

2.01 FIELD PANELS

- A. Field panels for outdoor service shall be suitable for wall or pipe mounting. Panels shall have the following features:
 - 1. Type 316L stainless steel NEMA 4X construction unless located in chlorine environments. Chlorine environment shall be nonmetallic NEMA 4X construction.
 - 2. Hinged and foamed-in-place continuous gasketed door(s). Door material shall match enclosure and shall have piano hinge(s) and three-point latches.
 - 3. Field panels located outside fence-secured areas shall be fitted with staple and hasp. Provide padlock and coordinate keying with CITY.
 - 4. Thermal insulation and thermostatically controlled space heaters where required to prevent condensation or maintain environmental conditions for installed components.
 - 5. 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-taped to prevent freezing. Heat taping shall be thermostatically controlled and self-regulating, and shall adjust its heat output to the temperature of the lines. Heat tape shall be powered from a GFCI circuit from within panel, unless otherwise shown or specified.

- 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 Hoffman, Saginaw Control and Engineering (SCE), or equal.

PART 3 -- EXECUTION

3.01 REQUIREMENTS

- A. Refer to Section 17500 for additional requirements.

A

- END OF SECTION -

SECTION 17560 – TRANSIENT VOLTAGE SURGE SUPPRESSION DEVICES

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. The CONTRACTOR shall furnish, install and place in satisfactory operation the transient voltage surge suppression (TVSS) devices as specified herein and as shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 17000 - Control and Information System Scope and General Requirements
- B. Section 17060 – Signal Conditioning Requirements
- C. Section 17500 – Enclosures, General
- D. Section 17550 – Panel Instruments and Accessories

1.03 GENERAL INFORMATION AND DESCRIPTION

- A. All surge protectors of each type provided under this Contract shall be furnished by a single manufacturer.

1.04 TOOLS, SUPPLIES AND SPARE PARTS

- A. The following specific spare parts items shall be provided:
 - 1. Five of each type of transient voltage surge suppression (TVSS) devices provided under this Contract.

PART 2 – PRODUCTS

2.01 ELECTRICAL TRANSIENT PROTECTION, GENERAL

- A. 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.
- B. Manufacturer's Requirements: All transient voltage surge suppressor devices shall be multi stage serial devices 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 or Engineer approved equal. Transient voltage surge suppressor device design requirements shall include the following:
 - 1. Transient voltage surge suppression devices shall be two part, DIN rail mounted, high density, plug-and-base modular terminal block format. The two part plug and base format shall facilitate arrestor module replacement without rewiring.
 - 2. Surge suppression devices shall provide a combination of wire to ground and wire to wire protection.

3. Suppression devices shall be grounded via the grounded DIN rail.
 4. Surge suppression devices shall be modular, single channel devices and shall utilize a combination of gas discharge tubes, varistors and suppression diodes in a multistage configuration to protect nominal voltage ranges between 5 VDC and 230 VAC.
 5. Each surge suppression module shall provide local LED indication of arrestor status as well as dry contact output for remote indication of arrestor status the associated PLC to alert when arrestor replacement is required.
 6. DIN rail mounted bases shall be modular type, screw or push-in wiring terminal type, with individually labeled terminals. Bases shall serve as the field terminal blocks between all panel-mounted devices and internal wiring and all field power, communications, I/O signal and ancillary wiring external to the panel.
- C. Surge protection device installations shall comply with UL 94, the National Electric Code (NEC), and all applicable local codes.
- D. Surge protection devices shall be installed as close to the equipment to be protected as practically possible.
- E. Suppressor Locations: As a minimum, provide surge suppressors at the following locations:
1. At all connections between AC power, DC power and associated electrical and electronic equipment, including panels, cabinets, and rack assemblies, as well as at field mounted powered instruments (where new field instrumentation devices are specified to be furnished and installed).
 2. Where new field instrumentation is specified to be furnished and installed, provide protection at both ends of all two-wire analog signal circuits and all four wire analog power/ signal circuits.
 3. Where existing field instrumentation is to be reconnected to modified and new local control panels, provide protection at the panel end of all two-wire analog signal circuits and all four wire analog power/ signal circuits.
 4. At the panel end of all analog inputs and outputs and all discrete input (dry contact) circuits and discrete output (24 VDC or relay contact) circuits that extend to all devices outside of the PLC enclosure. Control panel field wiring terminal blocks for all discrete and analog inputs and outputs shall be DIN rail mounted, modular type with integral transient voltage surge suppression and other signal isolation and protective devices, as required. Terminal block wiring connections shall be screw or push-in type and shall accept 24-14 AWG wire; rated for the signals carried and labeled as manufactured by Phoenix Contact, or equal.
 5. At each device termination point of copper-based communication cables (serial, parallel, Ethernet, Device Net, etc.).
 6. On all telephone communications lines.
 7. RF antenna cable radio terminus.

F. Surge suppressors shall be as follows:

1. 120-Volt power surge suppressor: The protector shall be PLUGTRAB series by Phoenix Contact, or Engineer approved equivalent.
2. 120-Volt powered, field mounted analog transmitter: The protector shall combine AC power protection and 4-20 mA signal line protection. The suppressor shall be SLAC series with continuous hinge Stainless Steel enclosure by EDCO or Engineer approved equivalent.
3. Two-wire field-mounted analog transmitter: 4-20 mA signal line protection shall be stainless steel pipe-type and shall be Phoenix Contact SURGETRAB S-PT1-24DC , or Engineer approved equivalent.
4. 4-20 mA analog input/output signal line protection at the panel side: The protector shall be PLUGTRAB IQ series by Phoenix Contact, or Engineer approved equivalent.
5. Two-wire discrete input/output signal line protection at the panel side: The protector shall be PLUGTRAB IQ series by Phoenix Contact, or Engineer approved equivalent.
6. Surge suppressors for copper-based data communication circuits: Shall be designed for the specific data communication media and protocol to be protected (e.g., telephone, serial, parallel, Ethernet, DeviceNet, coax, twinaxial, twisted pair, RF, etc.), and shall provide protection of equipment to within the equipment's surge withstand levels for applicable standard test wave forms of the following standards:
 - a. IEC 60-1 / DIN VDE 0432 part 2
 - b. CCITT K17 / DIN VDE 0845 part 2
 - c. IEEE C62.31

Shall be PLUGTRAB IQ, PLUGTRAB, or DATATRAB by Phoenix Contact, or Engineer approved equivalent.

PART 3 – EXECUTION

3.01 REQUIREMENTS

- A. Install in accordance with manufacture recommended practices and applicable codes.
- B. Refer to Section entitled "Enclosures, General" for additional requirements.

- - END OF SECTION - -

SECTION 17600 - UNPOWERED INSTRUMENTS - GENERAL

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, install, test and place in operation unpowered process instrumentation (flow elements, level switches, analysis elements, detectors, etc.) as shown on the Contract Drawings and as specified.
- B. It is the intent of this Specification and the Contract Documents that all process taps, isolation valves, nipples, penetrations, embedded instrumentation supports, conduit, wiring, terminations, and the installation of unpowered process instrumentation on process lines shall be provided under this Contract.
- C. Tappings and connections for primary process sensors shall be sized to suit each individual installation and the requirements of the instrument served. It is the Contractor's responsibility to ensure that the location, supports, orientation and dimensions of the connections and tappings for instrumentation furnished under this Division 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 QUALITY ASSURANCE

- A. The following organizations have generated standards that are to be used as guides in assuring quality and reliability of components and systems; govern nomenclature and define parameters of configuration and construction:
 1. ISA - Instrument Society of America.
 2. OSHA - Occupational Safety and Health Administration.
 3. EPA - Environmental Protection Agency.
 4. ANSI - American National Standards Institute.
 5. Refer to Division 16 for additional electrical standards and requirements.

PART 2 -- PRODUCTS

2.01 GENERAL

- A. Unless otherwise specified, instruments shall be of rugged materials of construction to suit specified environmental conditions. Instruments shall be mounted on walls, pipe stanchions on in-line as specified.

PART 3 -- EXECUTION

3.01 INSTALLATION

- A. General: Equipment shall be located so that it is accessible for operation and maintenance. The instrumentation subcontractor shall examine the Contract 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.
- B. Equipment Mounting and Support
 - 1. Field equipment shall be wall mounted or mounted on two-inch diameter aluminum pipe stands welded to a 10-inch square ½-inch thick aluminum steel base plate unless shown adjacent to a wall or otherwise noted. Instruments attached directly to concrete shall be spaced out from the mounting surface not less than ½-inch by use of phenolic spacers. Expansion shields 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 304 stainless steel pipe, ASA B-36.19, with stainless steel blind flange for equipment mounting as shown on the Contract Drawings.
 - 3. Materials for miscellaneous mounting brackets and supports shall be Type 304 stainless steel construction.
 - 4. Pipe stands, miscellaneous mounting brackets and supports shall comply with the requirements of Division 5 of the Specifications.

3.02 ADJUSTMENT AND CLEANING

- A. General
 - 1. The Contractor shall comply with the requirements of Division 1 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 its designated representative(s), reserve the right to witness any test, inspection, calibration or start-up activity. Acceptance by the Engineer of any plan, report or documentation relating to any testing or commissioning activity specified herein shall not relieve the Contractor of its responsibility for meeting all specified requirements.
 - 2. The Contractor 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. Any instrument which fails to meet any contract requirements, or any 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 CITY. 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.

- 3. At least 60 days before the anticipated initiation of installation testing, the Contractor shall submit to the Engineer a detailed description, in duplicate, of the installation tests to be conducted to demonstrate the correct operation of the instrumentation and control system.
- B. Calibration Requirements
 - 1. The Contractor shall supply factory calibration data for Engineer's information and/or review for the following:
 - a. Instruments that are generally factory calibrated.
 - b. Instruments that are specified to be factory calibrated.
 - c. Instruments that have calibration curve based upon empirical data.
 - 2. The Contractor shall provide the services of factory trained instrumentation technicians, tools and equipment to field calibrate each instrument supplied under this Contract to its specified accuracy in accordance with the manufacturer's specification and instructions for calibration.
 - 3. Each instrument shall be calibrated at 10, 50 and 90 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 accuracies as set forth by the National Bureau of Standards.
 - 4. The Contractor shall provide a written calibration sheet to the Engineer for each instrument, certifying that it has been calibrated to its published specified accuracy. The Contractor shall submit proposal calibration sheets for various types of instruments for Engineer approval prior to the start of calibration. This sheet shall include but be limited to date, instrument tag numbers, 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.
 - 5. If doubt exists as to the correct method for calibrating or checking the calibration of an instrument, the manufacturer's printed recommendations shall be used as an acceptable standard, subject to the approval of the Engineer.
 - 6. Upon completion of calibration, devices shall not be subjected to 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 overvoltage, incorrect voltages, overpressure or incorrect air. Damaged equipment shall be replaced and recalibrated at no cost to the CITY.

- END OF SECTION -

SECTION 17650 - 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 17600 – Unpowered Instruments, General
- B. Section 17698 – Instrumentation and Control System Accessories

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 the approximately 75% of the full-scale range.
- C. Features
 - 1. Mounting: ½-inch 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 2-inch for line sizes up to 3-inch and 4½-inch for line sizes of 4-inch or greater.

- F. Diaphragm seals and isolating ring seals shall be furnished in accordance with the requirements specified under the Section entitled "Instrumentation and Control System Accessories".
- G. The complete gauge assembly and appurtenances shall be fully assembled and tested prior to field mounting. A ½-inch 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 the Section entitled "Unpowered Instruments, General".

- END OF SECTION -

SECTION 17675 - PRESSURE SWITCHES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, test, install and place in satisfactory operation the pressure 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 17000 – Control and Information System Scope and General Requirements
- B. Section 17600 – Unpowered Instruments, General

PART 2 -- PRODUCTS

2.01 PRESSURE SWITCHES

- A. Pressure, vacuum, and differential pressure switches shall be single or dual action with an adjustable setpoint for the process requirement and/or as specified herein. Switches shall be diaphragm or piston operated and activate S.P.D.T. snap action switches on increasing or decreasing pressure. Minimum differential shall be less than 10 percent of the range. Deadband shall be adjustable. Allowable surge pressure shall be a minimum 1.5 times the range. Each pressure switch shall have visible scale.
- B. Pressure switches shall have a contact rating of 10 amperes at 120 volts AC. Pressure switches shall be in NEMA 4X enclosures. Switches shall have a repeatable accuracy of 1 percent of range. Pressure switches shall be isolated from the process fluid by a diaphragm seal or an isolation ring in locations as shown on the Contract Drawings and/or as specified. Wetted parts materials shall be compatible with the process fluid for corrosion resistance. Pressure switches shall be manufactured by ASCO, SOR, Inc., Ashcroft, or equal.

PART 3 -- EXECUTION

3.01 REQUIREMENTS

- A. Refer to Section 17600 Part 3.

- END OF SECTION -

SECTION 17698 - INSTRUMENTATION AND CONTROL SYSTEM ACCESSORIES

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.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. 17600 – Unpowered Instruments, General

PART 2 -- PRODUCTS

2.01 INSTRUMENTATION AND CONTROL SYSTEM ACCESSORIES

- A. General: 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 subarticle shall be used as a guide to qualify requirements for miscellaneous hardware whether the specific item is described or not.
- B. Process Tubing: Process tubing shall be 1/2-inch x 0.065-inch seamless, annealed, ASTM A-269 Type 316L stainless steel with Type 316 - 37 degrees stainless steel flared fittings or Swagelock or Parker-CPI flareless fittings.
- C. Power, Control and Signal Cables: Power, control and signal wiring shall be provided under Division 16 of the Specifications.
- D. Isolating Ring Seals: 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 - Wherever the associated pressure instrument is used for control purposes, the sensor body shall be full line size wafer design. Except where noted on the Drawings and/or Instrument Schedule, full line size ring seals will have tapped ring seals as specified in Item 2, below. Full line size isolating ring seals shall have Type 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. The captive liquid chamber and associated instrument(s) shall be furnished with threaded drain tap and plug. Isolating ring seals shall be RED Valve Series 40, Ronningen-Petter Iso-Ring, Moyno RKL Series W, Onyx Isolator Ring, or equal.
 - 2. Tapped Isolating Ring Seals - For all other solids bearing fluids, pressure shall be sensed via a minimum 1/2-inch diameter spool-type isolating ring seal mounted on a 1/2-inch pipe nipple at 90 degrees from the process piping. 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 pressure instrument shall be back or side mounted to the ring seal such that the gauge or readout may be viewed normally. Tapped isolating ring seals for solids service shall be Red Valve Series 42/742, Ronningen-Petter Iso-Spool, Onyx Isolator Ring, or equal.

- E. Filling Medium: 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°F to +150°F. Filling medium shall be silicone unless oxidizing agents such as sodium hypochlorite are present, where halocarbon shall be used.
- F. Isolation Valves: Isolation valves shall be ½-inch diameter ball valves with Type 316 stainless steel body, Type 316 stainless steel ball, except that materials of construction shall be suitable for the associated process fluid where applicable (i.e., chemical service).

PART 3 – EXECUTION (NOT USED)

- END OF SECTION -

SECTION 17700 - POWERED INSTRUMENTS, GENERAL

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, install, test and place in operation powered process instrumentation (flow elements, level transmitters, etc.) as scheduled herein together with all signal converters, transmitters, isolators, amplifiers, etc. to interface all instrumentation, panels, controls and process equipment control panels with the process control system as shown on the Drawings and as specified. Powered instruments are those instruments which require power (120 VAC or 24 VDC loop power) to operate.
- B. It is the intent of this Specification and 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.
- C. Tappings and connections for primary process sensors shall be sized to suit each individual installation and the requirements of the instrument served. It is the Contractor's responsibility to ensure that the location, supports, orientation and dimensions of the connections and tappings for instrumentation furnished under this Division 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 GENERAL INFORMATION AND DESCRIPTION

- A. These Specifications are intended to give a general description of what is required, but do not cover all details which will vary in accordance with the requirements of the equipment furnished. They are, however, intended to cover the furnishing, the shop testing, the delivery and complete installation and field testing, of all powered instruments and appurtenances whether specifically mentioned in the Specification or not.
- B. The powered instruments shall be furnished and installed with all necessary accessory equipment and auxiliaries whether specifically mentioned in these Specifications or not. These installations shall incorporate the highest standards for the type of service shown on the Drawings including loop testing of the entire installation and instruction of operating personnel in the care, operation, calibration and maintenance of all powered instrumentation.
- C. All the powered instrumentation shall be of first class workmanship and shall be entirely designed and suitable for the intended services. All materials used in fabricating the equipment shall be new and undamaged.

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 Class, Group, and Division as shown on the Drawings, to comply with the National Electrical Code.
- C. All instruments shall return to accurate measurement without manual resetting upon restoration of power after a power failure.
- D. 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 Subsection 3.01 (B) herein. All indicator readouts shall be linear in process units. Readouts of 0-100% shall not be acceptable (except for speed and valve position). Floating outputs shall be provided for all transmitters.
- E. Unless otherwise specified, field instrument and power supply enclosures shall be Type 316 stainless steel, fiberglass or PVC coated copper free cast aluminum NEMA 4X construction.
- F. 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.
- G. 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 -15 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.
- H. 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 which are currently in production. All equipment provided, where applicable, shall be of modular construction and shall be capable of field expansion.
- I. All non-loop-powered instruments and equipment shall be designed to operate on a 60 Hz alternating current 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.
- J. All analog transmitter and controller outputs shall be isolated, 4-20 milliamps into a load of 0-750 ohms, unless specifically noted otherwise. All switches shall have double-pole, double-throw contacts rated at a minimum of 600 VA, unless specified otherwise.
- K. Materials and equipment used shall be U.L. 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 Contractor 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. Electrical work shall be performed in compliance with all applicable local codes and practices. Where these specifications and the Drawings do not delineate precise installation procedures, API RP550 shall be used as a guide to installation procedures.

B. Equipment Mounting and Support

1. Field equipment shall be wall mounted or mounted on 2-inch diameter aluminum pipe stands welded to a 10-inch square ½-inch thick aluminum base plate unless shown adjacent to a wall or otherwise noted. Instruments attached directly to concrete shall be spaced out from the mounting surface not less than ½-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 as shown on the Drawings.
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 5 of the specifications.
5. Transmitters shall be oriented such that output indicators are readily visible.

- C. Control and Signal Wiring: 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. General

1. The Contractor shall comply with the requirements of Division 1 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 its designated representative, reserves the right to witness any test, inspection, calibration or start-up activity.

Acceptance by the Engineer of any plan, report or documentation relating to any testing or commissioning activity specified herein shall not relieve the Contractor of its responsibility for meeting all specified requirements.

2. The Contractor 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. Any instrument which fails to meet any contract requirements, or any 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 CITY. 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.
3. At least 60 days before the anticipated initiation of installation testing, the Contractor shall submit to the Engineer a detailed description, in duplicate, of the installation tests to be conducted to demonstrate the correct operation of the instrumentation supplied hereunder.

B. Field Instrument Calibration Requirements

1. The Contractor shall provide the services of factory trained instrumentation technicians, tools and equipment to field calibrate each instrument supplied under this Contract to its specified accuracy in accordance with the manufacturer's specification and instructions for calibration.
2. Each instrument shall be calibrated 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 accuracies as set forth by the National Institute for Standards and Technology (NIST).
3. The Contractor shall provide a written calibration 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 be limited to date, instrument tag numbers, 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.
4. If doubt exists as to the correct method for calibrating or checking the calibration 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 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 overvoltage, incorrect voltages, overpressure or incorrect air. Damaged equipment shall be replaced and recalibrated at no cost to the CITY.

6. After completion of instrumentation installation, the Contractor 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 17701 - MAGNETIC FLOW METERS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, test, install and place in satisfactory operation the magnetic 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. 17700 – Powered Instruments, General

PART 2 -- PRODUCTS

2.01 MAGNETIC FLOW METER SYSTEMS

- A. Magnetic flow meter systems shall include a magnetic flow tube and a microprocessor-based "smart" transmitter that is capable of converting and transmitting a signal from the flow tube. Magnetic flow meters shall utilize the characterized field principle of electromagnetic induction, and shall produce DC signals directly proportional to the liquid flow rate.
- B. Each meter shall be furnished with a stainless steel metering tube and carbon steel flanges with a polyurethane, ceramic, neoprene, or Teflon liner as required by the application and/or as specified herein. Liner shall have a minimum thickness of 0.125 inches. The inside diameter of the liner shall be within 0.125 inches of the inside diameter of the adjoining pipe. Liner protectors shall be provided on all flow tubes.
- C. The flow tube shall be provided with flush mounted electrodes.
- D. Grounding rings shall be provided for all meters.
- E. All materials of construction for metallic wetted parts (electrodes, grounding rings, etc.) shall be minimum Type 316 stainless steel, but shall be compatible with the process fluid for each meter in accordance with the recommendations of the manufacturer.
- F. Flow tube shall be rated for pressures up to 1.1 times the flange rating of adjacent piping. System shall be rated for ambient temperatures of -30 to +65 degrees C. The flow tube and electrical connection shall meet NEMA 6P or IPS68 rating for continuous submergence under 3 meters of water. The transmitter housing shall meet NEMA 4X requirements as a minimum.
- G. The transmitter shall provide pulsed DC coil drive current to the flow tube and shall convert the returning signal to a linear, isolated 4-20 mA DC signal. The transmitter shall utilize "smart" electronics and shall contain automatic, continuous zero correction, signal processing routines for noise rejection, and an integral LCD readout capable of displaying flow rate and totalized flow. The transmitter shall continuously run self-diagnostic routines and report errors via English language messages.
- H. The transmitter's preamplifier input impedance shall be a minimum of 10^9 - 10^{11} ohms which shall make the system suited for the amplification of low-level input signals and capable of operation with a material build up on the electrodes.

- I. The transmitter shall provide an automatic low flow cutoff below a user configurable low flow condition (0-10%). The transmitter's outputs shall also be capable of being forced to zero by an external dry contact operation.
- J. Each flow tube shall be factory calibrated and assigned a calibration constant or factor to be entered into the associated transmitter as part of the meter configuration parameters. Manual calibration of the flow meter shall not be required. Meter configuration parameters shall be stored in non-volatile memory in the transmitter. An output hold feature shall be provided to maintain a constant output during configuration changes.
- K. The transmitter shall be equipped with a built-in web server capable of generating a traceable meter verification report in .PDF format that can be downloaded to a PC via Ethernet TCP/IP communications.
- L. Accuracy shall be a minimum of 0.30% of rate over the flow velocity range of 0.3 to 10.0 m/s. Repeatability shall be 0.1% of rate; minimum rangeability shall be 100:1. Minimum required liquid conductivity shall not be greater than 5 uS/cm. Maximum response time shall be adjustable between 1 and 100 seconds as a minimum. Transmitter ambient temperature operating limits shall be -10 to +50 degrees C. Power supply shall be 115 VAC, 60 Hz.
- M. Flow tubes shall be 150-lb flange mounted unless otherwise noted.
- N. The cables for interconnecting the meter and transmitter shall be furnished by the manufacturer. Instrumentation subcontractor shall coordinate with Electrical subcontractor to select appropriate cable length. The cable shall be terminated and potted by the manufacturer at the flow tube to prevent moisture intrusion. The cable shall be terminated in the field at the transmitter in a manner that will not reduce meter performance and in accordance with manufacturer recommendations. Long lengths of coiled cable is not acceptable.
- O. Transmitter shall be mounted integrally on flow tube, wall, or 2-inch pipe mounted as shown in the Drawings and/or as specified.
- P. Magnetic flow meter systems shall be Proline Promag W 400 with optional high accuracy calibration and "Heartbeat" Technology option, as manufactured by Endress + Hauser or equivalent by Rosemount, ABB, Krohne, Siemens or equal.

PART 3 -- EXECUTION

3.01 REQUIREMENTS

- A. Install flow tubes, cables, and transmitters in strict accordance with the manufacturer's recommendations. Do not disconnect manufacturer-terminated cables from the flow tube.
- B. Ground flow tubes and grounding rings in strict accordance with the manufacturer's recommendations.

- END OF SECTION -

SECTION 17910 - INSTRUMENT SCHEDULE

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. Although every effort has been made to ensure an accurate instrument schedule, errors may have been made. Contractor shall furnish, test, install and place in satisfactory operation all instrumentation as herein specified, and Contractor shall furnish, test, install and place in satisfactory operation all instrumentation as shown on the Drawings.
- B. Only new instrumentation is scheduled, unless existing instrumentation needs modifications that are not otherwise shown or specified. Contractor shall bring any existing instrumentations' deficiencies to the Engineer's attention.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Control System Input/Output Schedule
- B. Functional Control Descriptions

PART 2 -- INSTRUMENT SCHEDULE

Pressure Gauges - Section 17650			
Tag Number	Service Description	State/Span	Remarks
PI-64501	RAS Pump No. 1 (RAS-64010) Suction Pressure	0-30 PSI	
PI-64511	RAS Pump No. 2 (RAS-64011) Suction Pressure	0-30 PSI	
PI-64521	RAS Pump No. 3 (RAS-64012) Suction Pressure	0-30 PSI	
PI-64010	RAS Pump No. 1 (RAS-64010) Discharge Pressure	0-60 PSI	
PI-64011	RAS Pump No. 2 (RAS-64011) Discharge Pressure	0-60 PSI	
PI-64012	RAS Pump No. 3 (RAS-64012) Discharge Pressure	0-60 PSI	
Pressure Switch - Section 17675			
Tag Number	Service Description	State/Span	Remarks
PSH-64010	Transfer Pump No. 1 (RAS-64010) Discharge Pressure High	0-60 PSI Set @ 55 psi	
PSH-64011	Transfer Pump No. 2 (RAS-64011) Discharge Pressure High	0-60 PSI Set @ 55 psi	
PSH-64012	Transfer Pump No. 3 (RAS-64012) Discharge Pressure High	0-60 PSI Set @ 55 psi	
Magnetic Flow Meters - Section 17701			
Tag Number	Service Description	State/Span	Remarks
FE/FIT-64410	RAS Pump Station No. 1 - WAS Flow	0 – 1,000 GPM	6" Flow Tube with neoprene liner
FE/FIT-64412	RAS Pump Station No. 3 - WAS Flow	0 – 1,000 GPM	6" Flow Tube with neoprene liner
FE/FIT-65412	RAS Pump Station No. 4 - WAS Flow	0 – 1,000 GPM	6" Flow Tube with neoprene liner

- END OF SECTION -

SECTION 17920 - CONTROL SYSTEM INPUT / OUTPUT SCHEDULE

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 and 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, including existing I/O, utilizing spares, 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.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Instrument Schedule
- B. Functional Control Descriptions

PART 2 -- CONTROL SYSTEM INPUT / OUTPUT SCHEDULE

DWG	SERVICE DESCRIPTION	STATE/SPAN	TYPE	PLC	TAG	COMMENTS
I-2	RAS PUMP No. 1 (RAS-64010) START/STOP	CONTROL	DO	PLC-7	YCR-64010	Reuse Existing: Rack: 1 Slot: 7 Point: 1 Quantum Address: %M49
I-2	RAS PUMP No. 1 (RAS-64010) SPEED COMMAND	CONTROL	AO	PLC-7	SC-64010	Reuse Existing: Rack: 1 Slot: 9 Point: 1 Quantum Address: %MW26
I-2	RAS PUMP No. 1 (RAS-64010) SPEED	STATUS	AI	PLC-7	SI-64010	Reuse Existing: Rack: 1 Slot: 8 Point: 2 Quantum Address: %IW2
I-2	RAS PUMP No. 1 (RAS-64010) IN REMOTE	STATUS	DI	PLC-7	YL-64010	Reuse Existing: Rack: 1 Slot: 5 Point: 2 Quantum Address: %I34
I-2	RAS PUMP No. 1 (RAS-64010) READY	STATUS	DI	PLC-7	JL-64010	Reuse Existing: Rack: 1 Slot: 4 Point: 2 Quantum Address: %I2
I-2	RAS PUMP No. 1 (RAS-64010) RUNNING	STATUS	DI	PLC-7	YLR-64010	Reuse Existing: Rack: 1 Slot: 4 Point: 1 Quantum Address: %I1
I-2	RAS PUMP No. 1 (RAS-64010) FAULT	ALARM	DI	PLC-7	YA-64010	Reuse Existing: Rack: 1 Slot: 4 Point: 3 Quantum Address: %I3
I-2	RAS PUMP No. 2 (RAS-64011) START/STOP	CONTROL	DO	PLC-7	YCR-64011	Reuse Existing: Rack: 1 Slot: 7 Point: 2 Quantum Address: %M50
I-2	RAS PUMP No. 2 (RAS-64011) SPEED COMMAND	CONTROL	AO	PLC-7	SC-64011	Reuse Existing: Rack: 1 Slot: 9 Point: 2 Quantum Address: %MW27
I-2	RAS PUMP No. 2 (RAS-64011) SPEED	STATUS	AI	PLC-7	SI-64011	Reuse Existing: Rack: 1 Slot: 8 Point: 3 Quantum Address: %IW3

DWG	SERVICE DESCRIPTION	STATE/SPAN	TYPE	PLC	TAG	COMMENTS
I-2	RAS PUMP No. 2 (RAS-64011) IN REMOTE	STATUS	DI	PLC-7	YL-64011	Reuse Existing: Rack: 1 Slot: 5 Point: 3 Quantum Address: %I35
I-2	RAS PUMP No. 2 (RAS-64011) READY	STATUS	DI	PLC-7	JL-64011	Reuse Existing: Rack: 1 Slot: 4 Point: 5 Quantum Address: %I5
I-2	RAS PUMP No. 2 (RAS-64011) RUNNING	STATUS	DI	PLC-7	YLR-64011	Reuse Existing: Rack: 1 Slot: 4 Point: 4 Quantum Address: %I4
I-2	RAS PUMP No. 2 (RAS-64011) FAULT	ALARM	DI	PLC-7	YA-64011	Reuse Existing: Rack: 1 Slot: 4 Point: 6 Quantum Address: %I6
I-2	RAS PUMP No. 3 (RAS-64012) START/STOP	CONTROL	DO	PLC-7	YCR-64012	Reuse Existing: Rack: 1 Slot: 7 Point: 3 Quantum Address: %M51
I-2	RAS PUMP No. 3 (RAS-64012) SPEED COMMAND	CONTROL	AO	PLC-7	SC-64012	Reuse Existing: Rack: 1 Slot: 9 Point: 4 Quantum Address: %MW29
I-2	RAS PUMP No. 3 (RAS-64012) SPEED	STATUS	AI	PLC-7	SI-64012	Reuse Existing: Rack: 1 Slot: 8 Point: 4 Quantum Address: %IW4
I-2	RAS PUMP No. 3 (RAS-64012) IN REMOTE	STATUS	DI	PLC-7	YL-64012	Reuse Existing: Rack: 1 Slot: 5 Point: 4 Quantum Address: %I36
I-2	RAS PUMP No. 3 (RAS-64012) READY	STATUS	DI	PLC-7	JL-64012	Reuse Existing: Rack: 1 Slot: 4 Point: 8 Quantum Address: %I8
I-2	RAS PUMP No. 3 (RAS-64012) RUNNING	STATUS	DI	PLC-7	YLR-64012	Reuse Existing: Rack: 1 Slot: 4 Point: 7 Quantum Address: %I7
I-2	RAS PUMP No. 3 (RAS-64012) FAULT	ALARM	DI	PLC-7	YA-64012	Reuse Existing: Rack: 1 Slot: 4 Point: 9 Quantum Address: %I9
I-2	RAS PUMP STATION NO. 1 - WAS FLOW RATE	Per §17910	AI	PLC-7	FI-64410	Reuse Existing: Rack: 1 Slot: 8 Point: 6 Quantum Address: %IW6 (change 4-20mA scale to 0-1,000 gpm)
I-2	MOV-64012 - POSITION COMMAND	0-100%	AO	PLC-7	ZC-64012	<i>New AO Module required. Coordinate assigned I/O with CITY or select and assign spare AO to existing PLC logic valve actuator function block.</i>
I-2	MOV-64012 - POSITION	0-100%	AI	PLC-7	ZI-64012	<i>New AI Module required. Coordinate assigned I/O with CITY or select and assign spare AI to existing PLC logic valve actuator function block.</i>
I-2	MOV-64012 - MALFUNCTION	ALARM	DI	PLC-7	YA-64012	Reuse Existing: Rack: 1 Slot: 5 Point: 8 Quantum Address: %I40
I-2	MOV-64012 - IN REMOTE	STATUS	DI	PLC-7	YL-64012	Reuse Existing: Rack: 1 Slot: 5 Point: 6 Quantum Address: %I38
I-2	MOV-64010 - POSITION COMMAND	0-100%	AO	PLC-7	ZC-64010	<i>New AO Module required. Coordinate assigned I/O with CITY or select and assign spare AO to existing PLC logic valve actuator function block.</i>
I-2	MOV-64010 - POSITION	0-100%	AI	PLC-7	ZI-64010	Reuse Existing: Rack: 1 Slot: 8 Point: 16 Quantum Address: %IW16

DWG	SERVICE DESCRIPTION	STATE/SPAN	TYPE	PLC	TAG	COMMENTS
I-2	MOV-64010 - MALFUNCTION	ALARM	DI	PLC-7	YA-64010	Reuse Existing: Rack: 1 Slot: 5 Point: 7 Quantum Address: %I39
I-2	MOV-64010 - IN REMOTE	STATUS	DI	PLC-7	YL-64010	Reuse Existing: Rack: 1 Slot: 5 Point: 5 Quantum Address: %I37
N/A	PV-64205 - POSITION COMMAND	0-100%	AO	PLC-7	ZC-64205	Reuse Existing: Rack: 1 Slot: 9 Point: 3 Quantum Address: %MW28
N/A	PV-64205 - POSITION	0-100%	AI	PLC-7	ZI-64205	Reuse Existing: Rack: 1 Slot: 8 Point: 13 Quantum Address: %IW13
N/A	PV-64205 - MALFUNCTION	ALARM	DI	PLC-7	YA-64205	Select and assign spare DI to existing PLC logic valve actuator function block input.
N/A	PV-64205 - IN REMOTE	STATUS	DI	PLC-7	YL-64205	Select and assign spare DI to existing PLC logic valve actuator function block input.
N/A	MOV-64013 - POSITION COMMAND	0-100%	AO	PLC-8	ZC-64013	Reuse Existing: Rack: 1 Slot: 8 Point: 5
N/A	MOV-64013 - POSITION	0-100%	AI	PLC-8	ZI-64013	Reuse Existing: Rack: 1 Slot: 7 Point: 15
N/A	MOV-64013 - MALFUNCTION	ALARM	DI	PLC-8	YA-64013	Select and assign spare DI to existing PLC logic valve actuator function block input.
N/A	MOV-64013 - IN REMOTE	STATUS	DI	PLC-8	YL-64013	Select and assign spare DI to existing PLC logic valve actuator function block input.
N/A	MOV-64015 - POSITION COMMAND	0-100%	AO	PLC-8	ZC-64015	Reuse Existing: Rack: 1 Slot: 8 Point: 6
N/A	MOV-64015 - POSITION	0-100%	AI	PLC-8	ZI-64015	Reuse Existing: Rack: 1 Slot: 7 Point: 16
N/A	MOV-64015 - MALFUNCTION	ALARM	DI	PLC-8	YA-64015	Select and assign spare DI to existing PLC logic valve actuator function block input.
N/A	MOV-64015 - IN REMOTE	STATUS	DI	PLC-8	YL-64015	Select and assign spare DI to existing PLC logic valve actuator function block input.
N/A	MOV-23010 - POSITION COMMAND	0-100%	AO	PLC-9	ZC-23010	<i>Coordinate assigned I/O with CITY or select and assign spare AO to existing PLC logic valve actuator function block.</i>
N/A	MOV-23010 - POSITION	0-100%	AI	PLC-9	ZI-23010	<i>Coordinate assigned I/O with CITY or select and assign spare AI to existing PLC logic valve actuator function block.</i>
N/A	MOV-23010 - MALFUNCTION	ALARM	DI	PLC-9	YA-23010	<i>Coordinate assigned I/O with CITY or select and assign spare DI to existing PLC logic valve actuator function block.</i>
N/A	MOV-23010 - IN REMOTE	STATUS	DI	PLC-9	YL-23010	<i>Coordinate assigned I/O with CITY or select and assign spare DI to existing PLC logic valve actuator function block.</i>
N/A	PV-64207 - POSITION COMMAND	0-100%	AO	PLC-9	ZC-64207	<i>Coordinate assigned I/O with CITY or select and assign spare AO to existing PLC logic valve actuator function block.</i>

DWG	SERVICE DESCRIPTION	STATE/SPAN	TYPE	PLC	TAG	COMMENTS
N/A	PV-64207 - POSITION	0-100%	AI	PLC-9	ZI-64207	Coordinate assigned I/O with CITY or select and assign spare AI to exiting PLC logic valve actuator function block.
N/A	PV-64207 - MALFUNCTION	ALARM	DI	PLC-9	YA-64207	Coordinate assigned I/O with CITY or select and assign spare DI to exiting PLC logic valve actuator function block.
N/A	PV-64207 - IN REMOTE	STATUS	DI	PLC-9	YL-64207	Coordinate assigned I/O with CITY or select and assign spare DI to exiting PLC logic valve actuator function block.
N/A	RAS PUMP STATION NO. 3 - WAS FLOW RATE	Per §17910	AI	PLC-9	FI-64412	Reuse Existing: Rack: 1 Slot: 7 Point: 10
N/A	MOV-24010 - POSITION COMMAND	0-100%	AO	PLC-15	ZC-24010	Coordinate assigned I/O with CITY or select and assign spare AO to exiting PLC logic valve actuator function block.
N/A	MOV-24010 - POSITION	0-100%	AI	PLC-15	ZI-24010	Coordinate assigned I/O with CITY or select and assign spare AI to exiting PLC logic valve actuator function block.
N/A	MOV-24010 - MALFUNCTION	ALARM	DI	PLC-15	YA-24010	Coordinate assigned I/O with CITY or select and assign spare DI to exiting PLC logic valve actuator function block.
N/A	MOV-24010 - IN REMOTE	STATUS	DI	PLC-15	YL-24010	Coordinate assigned I/O with CITY or select and assign spare DI to exiting PLC logic valve actuator function block.
N/A	PV-65207 - POSITION COMMAND	0-100%	AO	PLC-15	ZC-65207	Reuse Existing: Rack: 1 Slot: 7 Point: 9
N/A	PV-65207 - POSITION	0-100%	AI	PLC-15	ZI-65207	Reuse Existing: Rack: 1 Slot: 9 Point: 1
N/A	PV-65207 - MALFUNCTION	ALARM	DI	PLC-15	YA-65207	Coordinate assigned I/O with CITY or select and assign spare DI to exiting PLC logic valve actuator function block.
N/A	PV-65207 - IN REMOTE	STATUS	DI	PLC-15	YL-65207	Reuse Existing: Rack: 1 Slot: 4 Point: 9
N/A	RAS PUMP STATION NO. 4 - WAS FLOW RATE	Per §17910	AI	PLC-15	FI-65412	Reuse Existing: Rack: 1 Slot: 7 Point: 10
N/A	MOV-24424 - POSITION COMMAND	0-100%	AO	PLC-10	ZC-24424	Reuse Existing: Rack: 3 Slot: 16 Point: 1
N/A	MOV-24424 - POSITION	0-100%	AI	PLC-10	ZI-24424	Coordinate assigned I/O with CITY or select and assign spare AI to exiting PLC logic valve actuator function block.
N/A	MOV-24424 - MALFUNCTION	ALARM	DI	PLC-10	YA-24424	Coordinate assigned I/O with CITY or select and assign spare DI to exiting PLC logic valve actuator function block.
N/A	MOV-24424 - IN REMOTE	STATUS	DI	PLC-10	YL-24424	Coordinate assigned I/O with CITY or select and assign spare DI to exiting PLC logic valve actuator function block.

DWG	SERVICE DESCRIPTION	STATE/SPAN	TYPE	PLC	TAG	COMMENTS
N/A	MOV-24414 - POSITION COMMAND	0-100%	AO	PLC-10	ZC-24414	Reuse Existing: Rack: 3 Slot: 16 Point: 2
N/A	MOV-24414 - POSITION	0-100%	AI	PLC-10	ZI-24414	Coordinate assigned I/O with CITY or select and assign spare AI to existing PLC logic valve actuator function block.
N/A	MOV-24414 - MALFUNCTION	ALARM	DI	PLC-10	YA-24414	Coordinate assigned I/O with CITY or select and assign spare DI to existing PLC logic valve actuator function block.
N/A	MOV-24414 - IN REMOTE	STATUS	DI	PLC-10	YL-24414	Coordinate assigned I/O with CITY or select and assign spare DI to existing PLC logic valve actuator function block.

Notes:

1. Input / Output types are as follows:

- DI - Discrete Input
- DO - Discrete Output
- AI - Analog Input
- AO - Analog Output

- END OF SECTION -

