Invitation for Bids

IFB-051-23-JJ

OXYGENATION FLOW DISTRIBUTION BOX ODOR CONTROL SYSTEM REPLACEMENT
ECSD Project Number: 9815

FOR THE

CITY OF HOLLYWOOD, FLORIDA (CITY)

IFB Issue Date: May 17, 2023
Questions Due Date: June 14, 2023
Submittal Due Date: June 21, 2023, at 3 p.m. ET

CITY OF HOLLYWOOD
IFB-051-23-JJ
OXYGENATION FLOW DISTRIBUTION BOX ODOR CONTROL SYSTEM REPLACEMENT
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SECTION I – INTRODUCTION

1.1 Purpose

The City of Hollywood, Florida (City) is seeking bids from qualified and experienced firms, hereinafter referred to as the Contractor or Bidder, to provide construction services for the Oxygenation Flow Distribution Box Odor Control System Replacement for the City, in accordance with the terms, conditions, and specifications contained in this solicitation. Responses to this solicitation are due by **June 21, 2023, by 3:00 PM EST**, and will be opened in a virtual public setting on **June 21, 2023, at 3:00 PM EST** at **www.OpenGov.com**.

Submittals shall be received electronically through OpenGov.com .

Submittals shall be considered an offer on the part of the bidder/proposer, which offer shall be deemed accepted upon approval of the City, and in case of default, the City reserves the right to accept or reject any or all bids/proposals, to waive irregularities and technicalities, and request new bids/proposals. The City also reserves the right to award any resulting agreement as it deems will best serve the interests of the city.

1.2 Pre-bid Conference and/or Site Visit (Non-Mandatory)

There will be a non-mandatory pre-bid conference and/or site visit scheduled for this solicitation. Attendance is required if the event is mandatory, and in the event that it is non-mandatory, it is strongly suggested that all Contractors attend the pre-bid conference and/or site visit to receive information that may be critical to their understanding of this solicitation.

May 24, 2023, at 3:30 p.m.,
Southern Regional Wastewater Treatment Plant
1621 N. 14th Avenue
Hollywood, Florida 33021,
First Floor Conference Room

Please keep in mind that site visits at other times might not be available. It is the sole responsibility of the Contractor to become familiar with the scope of the City's requirements prior to submitting a bid. No variation in price or conditions shall be permitted based upon a claim of ignorance. Submission of a bid will be considered evidence that the Bidder has familiarized themselves with the nature and extent of the work, equipment, materials, and labor required.

1.3 OpenGov

The City of Hollywood uses OpenGov (https://procurement.opengov.com/portal/hollywoodfl) to administer the competitive solicitation process, including but not limited to soliciting bids, issuing addenda, posting results and issuing notification of an intended decision.

The City shall not be responsible for a Bidders inability to submit a bid by the bid end date and time for any reason, including issues arising from the use of OpenGov.

1.4 Point of Contact

For information concerning procedures for responding to this solicitation, contact the Point of Contact within the Office of Procurement, Jean Joinville, Senior Purchasing Agent at jjoinville@hollywoodfl.org or by phone at (954) 921-3290, or Staci Alli, Administrative Assistant at salli@hollywoodfl.org or by phone at 954-921-3222. Such contact is to be for clarification purposes only. All questions must be submitted in writing via OpenGov by **June 14, 2023, by 5:00 PM EST,** in order to receive a timely response.

Project Manager: Juan Figueroa, Department of Public Utilities, email: jfigueroa@hollywoodfl.org or by phone: (954) 921-3930.

For information concerning technical specifications, please utilize the question / answer feature provided by OpenGov at https://procurement.opengov.com/portal/hollywoodfl. Questions of a material nature must be received prior to the cut-off date specified in the solicitation schedule. Material changes, if any, to the scope of services or bidding procedures will only be transmitted by written addendum. (See addendum section of OpenGov Site). Bidders please note: No part of your bid can be submitted via FAX. No variation in price or conditions shall be permitted based upon a claim of ignorance. Submission of a bid will be considered evidence that the Bidder has familiarized themselves with the nature and extent of the work, and the equipment, materials, and labor required. The entire bid response must be submitted in accordance with all specifications contained in this solicitation. The questions and answers submitted in OpenGov shall become part of any contract that is created from this solicitation.

It is the sole responsibility of the Bidder to ensure that their bid is submitted electronically through OpenGov at https://procurement.opengov.com/portal/hollywoodfl.

1.5 Cone of Silence

The City of Hollywood City Commission adopted Ordinance No. O-2007-05, which created Section 30.15(F) 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 with 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, go to the City of Hollywood Code of Ordinance online, and view Section 30.15F.

All communications regarding this bid should be sent in writing to the Procurement Services Division as identified in this bid.

END OF SECTION

SECTION II - SPECIAL TERMS AND CONDITIONS

2.1 Addenda, Changes, and Interpretations

It is the sole responsibility of each firm to notify the Point of Contact utilizing the question / answer feature provided by OpenGov and request modification or clarification of any ambiguity, conflict, discrepancy, omission or other error discovered in this competitive solicitation. Requests for clarification, modification, interpretation, or changes must be received prior to the Question and Answer (Q & A) Deadline. Requests received after this date may not be addressed. Questions and requests for information that would not materially affect the scope of services to be performed or the solicitation process will be answered within the question / answer feature provided by OpenGov and shall be for clarification purposes only. Material changes, if any, to the scope of services or the solicitation process will only be transmitted by official written addendum issued by the City and uploaded to OpenGov as a separate addendum to the solicitation. Under no circumstances shall an oral explanation given by any City official, officer, staff, or agent be binding upon the City and should be disregarded. All addenda are a part of the competitive solicitation documents and each firm will be bound by such addenda. It is the responsibility of each to read and comprehend all addenda issued.

2.2 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.

2.3 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.

2.4 Changes and Alterations

Bidder may change or withdraw a Bid at any time prior to Bid submission deadline; however, no oral modifications will be allowed. Modifications shall not be allowed following the Bid deadline.

2.5 Bidder's Costs

The City shall not be liable for any costs incurred by Bidders in responding to this solicitation.

2.6 Pricing/Delivery

All pricing must include delivery and installation and be quoted FOB: Destination, unless specified otherwise in Section III.

2.7 Price Validity

Prices provided in this solicitation shall be valid for at least One-Hundred and Twenty (120) days from time of solicitation opening unless otherwise extended and agreed upon by the City and Bidder.

2.8 No Exclusive Contract

Bidder agrees and understands that the contract shall not be construed as an exclusive arrangement and further agrees that the City may, at any time, secure similar or identical services from another vendor at the City's sole option.

2.9 Responsive

In order to be considered responsive to the solicitation, the firm's bid shall fully conform in all material respects to the solicitation and all of its requirements, including all form and substance.

2.10 Responsible

In order to be considered as a responsible firm, firm shall be fully capable to meet all of the requirements of the solicitation and subsequent contract, must possess the full capability, including financial and technical, to perform as contractually required, and must be able to fully document the ability to provide good faith performance.

2.11 Minimum Qualifications

To be eligible for award of a contract in response to this solicitation, the Bidder must demonstrate that they have successfully completed services, as specified in Section III of this solicitation, are normally and routinely engaged in performing such services, and are properly and legally licensed (if required) to perform such work. Bidder must possess, and be able to provide the City with any and all required Federal, State, County and/or municipal licenses, and occupational licenses. Bidder must be able to provide proof of valid licensing for all subcontractors and/or material suppliers hired by the contractor, if requested. In addition, the Bidder must have no conflict of interest with regard to any other work performed by the Bidder for the City.

2.12 Award of Contract

Award may be in the aggregate, or by line Item, or by group, whichever is determined to be in the best interest of the City.

The Contract will be awarded only to a Bidder, who in the opinion of the Engineer, is fully qualified to undertake the work, quoting the lowest price, for that product/service that will best serve the needs of the City. 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.

The City also reserves the right to accept or reject any or all bids, part of bids, and to waive minor irregularities or variations to specifications contained in bids, and minor irregularities in the bidding process. The City also reserves the right to award the contract on a split order basis, lump sum basis, individual item basis, or such combination as shall best serve the interest of the City.

2.13 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.

2.14 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 Section 2.13 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. 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.

2.15 Manufacturer/Brand/Model Specific Request

This is a manufacturer/brand/model specification. No substitutions will be allowed unless specified in Form 3 or Attachment D, – Technical Specifications.

2.16 Permits and Fees Refer to Attachment D – Technical Specifications (Section 01025 Basis of Payment)

2.17 Contract Security

When the awarded bidder delivers the executed contract to the City, it must be accompanied by the required bonds.

2.18 Contract Period

The initial contract term shall commence upon date of award by the City for a twelve-month term.

In the event services are scheduled to end because of the expiration of this contract, the Contractor shall continue the service upon the request of the City as authorized by the awarding authority. The extension period shall not extend for more than 120 days beyond the expiration date of the existing contract. The Contractor shall be compensated for the service at the rate in effect when this extension clause is invoked by the City.

2.19 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 5% of the Bid is required for this project.

2.20 Warranties of Usage

Any estimated quantities listed are for information and tabulation purposes only. No warranty or guarantee of quantities needed is given or implied. It is understood that the Contractor will furnish the City's needs as they arise.

2.21 Rules and Submittals of Bids

The signer of the bid must declare that the only person(s), company or parties interested in the proposal as principals are named therein; that the bid is made without collusion with any other person(s), company or parties submitting a bid; that it is in all respects fair and in good faith, without collusion or fraud; and that the signer of the bid has full authority to bind the principal bidder.

2.22 Tie Breaker

In cases where there is a tie for the bid award, the award shall be made by giving preference to the low bidder(s) with the following items (in this order): (1) maintenance of a drug-free workplace in accordance with the requirements of Florida Statutes Section 287.087, (2) local Hollywood vendor preference, (3) closest proximity/location to project site or City Hall, and/or (4) minority-owned or disadvantaged business status. If a tie still exists after the aforementioned tiebreakers are utilized, the Chief Procurement Officer will make a recommendation for award among the tied bidders.

2.23 Conflict of Interests Prohibited

Any respondent submitting a response to this solicitation is responsible for being aware of, and complying with Section 34.02 of the City Code of Ordinances. If you have questions concerning whether you may or may not need to comply with the ordinance, please contact the City of Hollywood, City Clerk's Office at 954-921-3211.

2.24 Protest Procedure

Any respondent who is not recommended for award of a contract and who alleges a failure by the City to follow the City's Procurement Code or any applicable law may protest to the CPO, by delivering a letter of protest to the CPO in accordance with Section 38.52 of the City's Procurement Code within five days after a notice of intent to award is posted on the City's web site, OpenGov, City Clerk's Office, Open Government, and/or City's Sunshine Board (https://www.hollywoodfl.org/Archive.aspx?AMID=140).

2.25 Insurance Requirements

Contractor shall maintain, at its sole expense, during the term of this agreement the following insurances:

The insurance required by Article 5.6 of the General Conditions, Public Utilities shall be as follows:
Any Sub-Contractor used by the contractor shall supply such similar insurance required of the contractor. Such certificates shall name the City of Hollywood as an Additional Insured.

A. Builders Risk (BR 1) - Installation Floater: (Not Applicable)

B. 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:

1. Premises Operations
2. Products and Completed Operations
3. Blanket Contractual Liability
4. Personal Injury Liability
5. Expanded Definition of Property Damage

The minimum limits acceptable shall be:

- $2,000,000 Combined Single Limit (CSL)

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

- $1,000,000 per Person
- $2,000,000 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 shall be named as Additional Insured on all policies issued to satisfy the above requirements.

C. General Liability (GLXCU):

Recognizing that the work governed by this contract involves either underground exposures, explosive activities, or the possibility of collapse of a structure, the Contractor's General Liability Policy shall include coverage for the XCU (explosion, collapse, and underground) exposures with limits of liability equal to those of the General Liability Insurance policy.

D. Vehicle Liability (VL3):

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:

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

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

- $500,000 per Person
- $1,000,000 per Occurrence
- $100,000 Property Damage

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

E. Workers' Compensation (WC2):

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:

- $500,000 Bodily Injury by Accident
- $500,000 Bodily Injury by Disease, policy limits
- $500,000 Bodily Injury by Disease, each employee

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

F. Pollution Liability Insurance

The minimum limits of liability shall be:

- $1,000,000 per each claim / $2,000,000 aggregate

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” and Class X, as assigned by the A.M. Best Company.

The policy must be endorsed to provide the City with (30) days’ notice of cancellation.

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.

Any sub-consultant shall supply such similar insurance required of the Consultant. Such certificates shall name the City as additional insured in the general liability and auto liability policies.

2.26 Uncontrollable Circumstances (Force Majeure)

The City and Contractor will be excused from the performance of their respective obligations under this agreement when and to the extent that their performance is delayed or prevented by any circumstances beyond their control including, fire, flood, explosion, strikes or other labor disputes, acts of God or public emergency, war, riot, civil commotion, malicious damage, act or omission of any governmental authority, delay or failure or shortage of any type of transportation, equipment, or service from a public utility needed for their performance, provided that:

2.26.1 The non performing party gives the other party prompt written notice describing the particulars of the Force Majeure including, but not limited to, the nature of the occurrence and its expected duration, and continues to furnish timely reports with respect thereto during the period of the Force Majeure;

2.26.2 The excuse of performance is of no greater scope and of no longer duration than is required by the Force Majeure; and

2.26.3 No obligations of either party that arose before the Force Majeure causing the excuse of performance are excused as a result of the Force Majeure; and

2.26.4 The non-performing party uses its best efforts to remedy its inability to perform. Notwithstanding the above, performance shall not be excused under this Section for a period in excess of two (2) months, provided that in extenuating circumstances, the City may excuse performance for a longer term. Economic hardship of the Contractor will not constitute Force Majeure. The term of the agreement shall be extended by a period equal to that during which either party's performance is suspended under this Section.

2.27 Supplier Portal (Oracle) Payment Method

The City has implemented software that contains a supplier portal allowing suppliers to submit and update their information via the supplier portal. New suppliers will be required to register; and current suppliers will need to confirm and update their information.

Firms are responsible for ensuring that all contact, payment, and general information is updated at all times, and will not hold the City liable for any inaccurate information.

2.28 Debarred or Suspended Bidders or Proposers

Firm(s) certifies, by submission of a response to this solicitation, that neither it nor its principals and subcontractors are presently debarred or suspended by any federal, state, county or municipal department or agency.

2.29 Payment and Performance Bond

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

2.30 Public Records

A. Public Records/Trade Secrets/Copyright:

All responses will become the property of the City. The Consultant's response to the solicitation is a public record pursuant to Florida law and is subject to disclosure by the City pursuant to Chapter 119.07, Florida Statutes ("Public Records law"). The City shall permit public access to all documents, papers, letters or other material submitted in connection with this solicitation and the Contract to be executed for this solicitation, subject to the provisions of Chapter 119, Florida Statutes.

Any language contained in the Consultant's response to the solicitation purporting to require confidentiality of any portion of the Consultant's response to the solicitation, except to the extent that certain information is in the City's opinion a Trade Secret pursuant to Florida law, shall be void. If a Consultant submits any documents or other information to the City that the Consultant claims is Trade Secret information and exempt from Florida Statutes Chapter 119.07 ("Public Records Laws"), the Consultant shall clearly designate that it is a Trade Secret and that it is asserting that the document or information is exempt. The Consultant must specifically identify the exemption being claimed under Florida Statutes 119.07. The City shall be the final arbiter of whether any information contained in the Consultant's response to the solicitation constitutes a Trade Secret. The City's determination of whether an exemption applies shall be final, and the Consultant agrees to defend, indemnify, and hold harmless the City and the City's officers, employees, and agent, against any loss or damages incurred by any person or entity as a result of the City's treatment of records as public records. In the event of Contract award, all documentation produced as part of the Contract shall become the exclusive property of the City. Proposals purporting to be subject to copyright protection in full or in part will be rejected.

EXCEPT FOR CLEARLY MARKED PORTIONS THAT ARE BONA FIDE TRADE SECRETS PURSUANT TO FLORIDA LAW, DO NOT MARK YOUR RESPONSE TO THE SOLICITATION AS PROPRIETARY OR CONFIDENTIAL. DO NOT MARK YOUR RESPONSE TO THE SOLICITATION OR ANY PART THEREOF AS COPYRIGHTED.

B. PUBLIC RECORDS GENERAL

IF THE CONSULTANT HAS QUESTIONS REGARDING THE APPLICATION OF CHAPTER 119, FLORIDA STATUTES, TO THE CONSULTANT'S DUTY TO PROVIDE PUBLIC RECORDS RELATING TO THIS CONTRACT, CONTACT THE CUSTODIAN OF PUBLIC RECORDS AT: (954-921-3211), pcerny@hollywoodfl.org, CITY CLERK'S OFFICE, 2600 HOLLYWOOD BLVD, HOLLYWOOD, FLORIDA 33020)

Consultant shall:

1. Keep and maintain public records that ordinarily and necessarily would be required by the City in order to perform the service.

2. Upon request from the City's custodian of public records, provide the City with a copy of the requested records or allow the records to be inspected or copied within a reasonable time at a cost that does not exceed the cost provided in Chapter 119, Florida Statutes.

3. Ensure that public records that are exempt or confidential and exempt from public records disclosure requirements are not disclosed except as authorized by law for the duration of the contract term and following completion of this contract if the Consultant does not transfer the records to the City.

4. Upon completion of the Contract, transfer, at no cost, to the City all public records in possession of the Consultant or keep and maintain public records required by the City to perform the service. If the Consultant transfers all public records to the City upon completion of this Contract, the Consultant shall destroy any duplicate public records that are exempt or confidential and exempt from public records disclosure requirements. If the Consultant keeps and maintains public records upon completion of this Contract, the Consultant shall meet all applicable requirements for retaining public records. All records stored electronically must be provided to the City, upon request from the City's custodian of public records, in a format that is compatible with the information technology systems of the City. It is solely and exclusively the Contractor's responsibility to familiarize itself with Chapter 119, Florida Statutes, and to ensure compliance with its requirements.

END OF SECTION

SECTION III - SCOPE OF SERVICES

3.1 Project Description

Work under this Contract consists of the furnishing of all labor, materials, equipment, services and incidentals for the construction of new odor control facilities and air handling system at the Oxygenation Flow Distribution Box at the Southern Regional Wastewater Treatment Plant. The project will include the demolition and removal of the existing facilities and the construction of new facilities as identified in the Contract Documents.

3.2 Technical Specifications

Refer to Attachment D.

3.3 Contractor Qualifications

The contract will be awarded only to a responsive contractor qualified by experience to do the Work specified. The bidder shall submit, prior to award of contract, satisfactory evidence of his experience in like Work and that he is fully prepared with the necessary organization, capital, equipment and machinery to complete the Work to the satisfaction of the City within the time limit stated. In addition to the above, the Contractor shall satisfy the following criteria:

1. The Bidder shall have successfully completed a minimum of three (3) relevant projects demonstrating experience with wastewater treatment facilities. These projects shall have been performed within the past three (3) years from the date of the Invitation to Bid.

2. Provide at least four (4) verifiable references for projects similar in size and scope or types of work as listed in this solicitation using the attached Form 4 - Vendor Reference Form.

Form 15 – Information Required from Bidders, shall be completed fully and accurately by the Contractor and submitted with the bid. Information included on the questionnaire will be used in evaluating the qualifications of the Contractor. The City reserves the right to request additional information not identified on the questionnaire.

3.4 Subcontractors

For the City to be assured that only competent and qualified subcontractors will be employed on this project, each Bidder shall submit in the bid a list of the subcontractors performing work on this project. This subcontractors list shall include each firm's name, address, telephone number, contact person and work to be performed. Subcontractors shall be properly registered or licensed with the State of Florida, Broward County and the City of Hollywood. Subcontractors shall, in the City's opinion, be qualified both technically and financially to perform the work.

The City reserves the right to reject any subcontractor who is deemed by the City to be unacceptable technically or financially, or has previously performed work which the City believes to be unsatisfactory. No change may be made to this list of subcontractors by the Contractor, before or after contract award, without the express written consent of the City.

If, prior to award, the City rejects any subcontractor, the Contractor shall be afforded the opportunity to submit qualifications for an alternate subcontractor with no attendant increase in the base lump sum bid amount, adjustment of contract time or alteration of the bid documents. Such qualifications will be due within ten (10) days of receipt of notification of subcontractor rejection. Failure to submit an acceptable

alternate subcontractor may result in rejection of the bid. In this event, the bid bond shall be returned to Contractor without claim by the City and with forfeiture of all claim rights by the Contractor.

3.5 Deliverables and Objectives

Refer to Attachment B General Conditions Public Utilities, Attachment C Supplementary General Conditions, Attachment D Technical Specifications and Attachment E Drawings.

3.6 Project Schedule / Timeline

Refer to Attachment C, Supplementary conditions, Section 1, Project Schedule.

3.7 Questions

Refer to Form 15, Information Required from Bidders.

3.8 Substantial Completion

Refer to Attachment C, Supplementary conditions, Section 1, Project Schedule.

END OF SECTION

SECTION IV – GENERAL TERMS AND CONDITIONS

1.1 INTENT

It is the policy of the City to encourage full and open competition among all available qualified vendors. All vendors regularly engaged in the type of Work specified in the Bid Solicitation are encouraged to submit bids. To receive notification and to be eligible to bid vendor should be registered with OpenGov. Vendors may register with the OpenGov (registration is free) to be included on a mailing list for selected categories of goods and Services. In order to be processed for payment, any awarded vendor must register with the City by completing and returning a Vendor Application and all supporting documents. For information and to apply as a vendor, please visit our website at **hollywoodfl.org** to download an application and submit it to Procurement Services Division.

It is the intent of the City of Hollywood, FL ("the City"), through this solicitation and the contract conditions contained herein, to establish to the greatest possible extent complete clarity regarding the requirements of both parties to the agreement resulting from this solicitation.

Before submitting a bid, the Vendor shall be thoroughly familiarized with all contract conditions referred to in this document and any addenda issued before the bid/proposal submission date. Such addenda shall form a part of the SOLICITATION and shall be made a part of the contract. It shall be the Vendor's responsibility to ascertain that the bid/proposal includes all addenda issued prior to the bid/proposal submission date. Addenda will be posted on the City's internet site along with the SOLICITATION.

The terms of the SOLICITATION and the selected Vendor's bid and any additional documentation (e.g. questions and answers) provided by the Vendor during the solicitation process will be integrated into the final contract for services entered into between the City and the selected Vendor. The Vendor shall determine, by personal examination and by such other means as may be preferred, the conditions and requirements under which the agreement must be performed.

1.2 PROPOSER'S RESPONSIBILITIES

Proposers are required to submit their bids upon the following express conditions:

A. Proposers shall thoroughly examine the drawings, specifications, schedules, instructions and all other contract documents.

B. Proposers shall make all investigations necessary to thoroughly inform themselves regarding delivery of material, equipment or services as required by the SOLICITATION conditions. No plea of ignorance, by the proposer, of conditions that exist or that may hereafter exist as a result of failure or omission on the part of the proposer to make the necessary examinations and investigations, or failure to fulfill in every detail the requirements of the contract documents, will be accepted as a basis for varying the requirements of the City or the compensation due the proposer.

C. Proposers are advised that all City contracts are subject to all legal requirements provided for in the City of Hollywood Charter, Code of Ordinances and applicable County Ordinances, State Statutes and Federal Statutes.

1.3 PREPARATION OF BIDS/PROPOSALS

Bids/proposals shall be prepared in accordance with the bid/proposal response format. Bids/proposals not complying with this format may be considered non-responsive and may be removed from consideration on this basis. Each proposer, by making a bid/proposal, represents that this document has been read and is fully understood.

Bids/proposals will be prepared in accordance with the following:

A. The City's enclosed bid/proposal Forms, in their entirety, are to be used in submitting your bid/proposal. NO OTHER FORM WILL BE ACCEPTED.

B. All information required by the bid/proposal form shall be furnished. The proposer shall sign each continuation sheet (where indicated) on which an entry is made.

C. Prices shall be shown and where there is an error in extension of prices, the unit price shall govern.

The City of Hollywood is exempt from payment to its vendors of State of Florida sales tax and, therefore, such taxes should not be figured into the SOLICITATION. However, this exemption does not apply to suppliers to the City in their (supplier) purchases of goods or services, used in work or goods supplied to the City. Proposers are responsible for any taxes, sales or otherwise, levied on their purchases, subcontracts, employment, etc. An exemption certificate will be signed where applicable, upon request. The City will pay no sales tax.

1.4 DESCRIPTION OF SUPPLIES (As Applicable)

Any manufacturer's names, trade names, brand names, or catalog numbers used in these applications are for the purpose of describing and establishing minimum requirements or level of quality, standards of performance, and design required, and are in no way intended to prohibit the bidding of other manufacturers' items of equal material, unless specifications state "NO SUBSTITUTIONS."

Proposers must indicate any variances to the specifications, terms, and conditions, no matter how slight. If variations are not stated in the bid/proposal, it shall be construed that the bid/proposal fully complies with the Specifications, Terms and Conditions.

Proposers are required to state exactly what they intend to furnish; otherwise they shall be required to furnish the items as specified.

Proposers will submit, with their bid/proposal, necessary data (factory information sheets, specifications, brochures, etc.) to evaluate and determine the quality of the item(s) they are proposing.

The City shall be the sole judge of equality and its decision shall be final.

1.5 ADDENDA

The Procurement Services Division may issue an addendum in response to any inquiry received, prior to bid/proposal opening, which changes, adds to or clarifies the terms, provisions or requirements of the solicitation. The Proposer should not rely on any representation, statement or explanation, whether written or verbal, other than those made in this solicitation document or in any addenda issued. Where there appears to be a conflict between this solicitation and any addendum, the last addendum issued shall prevail. It is the proposer’s responsibility to ensure receipt of all addenda and any accompanying documents. Proposer(s) shall acknowledge receipt of any formal Addenda by signing the addendum and including it with their bid/proposal. Failure to include signed formal addenda in its bid/proposal shall cause the City to deem the bid/proposal non-responsive provided, however, that the City may waive this requirement in its best interest.

1.6 REJECTION OF BIDS/PROPOSALS

To the extent permitted by applicable state and federal laws and regulations, the City reserves the right to reject any and all bids/proposals, to waive any and all informalities, irregularities and technicalities not involving price, time or changes in the commodities and/or services, and the right to disregard all nonconforming, non-responsive, unbalanced or conditional bids/proposals. Bids/proposals will be considered irregular and may be rejected if they show serious omissions, alterations in form, additions not called for, conditions or unauthorized alterations or irregularities of any kind.

The City also reserves the right to waive minor technical defects in a bid/proposal. The City reserves the right to determine, in its sole discretion, whether any aspect of a bid/proposal satisfies the criteria established in this Solicitation.

The City reserves the right to reject, in whole or in part, the bid/proposal of any Proposer if the City believes that it would not be in the best interest of the City to make an award to that Proposer, whether because the bid/proposal is not responsive or the Proposer is unqualified or of doubtful financial ability or fails to meet any other pertinent standard or criterion established by City.

The foregoing reasons for rejection of bids/proposals are not intended to be exhaustive.

The City may reject a bid/proposal if:

A. The Proposer fails to acknowledge receipt of an addendum, or if

B. The Proposer misstates or conceals any material fact in the bid/proposal, or if

C. The bid/proposal does not strictly conform to the law or requirements of the SOLICITATION, or if

D. The City is under a pre- lawsuit claim or current litigation with the proposer.

Additionally, any one of the following causes (not limited to) may be considered as sufficient justification to disqualify a Bidder and reject his/her 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.
F. Lack of responsibility as shown by past work judged by the Engineer from the standpoint of workmanship and progress.
G. 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

The City may reject all bids whenever it is deemed in the best interest of the City to do so, and may reject any part of a bid unless the bid has been qualified as provided in herein.

1.7 WITHDRAWAL OF BIDS

A. Bids may not be withdrawn and shall be deemed enforceable for a period of 180 days after the time set for the SOLICITATION opening.

B. Bids may be withdrawn prior to the time set for the SOLICITATION opening. Such request must be in writing.

C. The City will permanently retain as liquidated damages and the bid deposit furnished by any Bidder who requests to withdraw a bid after the SOLICITATION opening.

1.8 BIDS TO REMAIN OPEN

All bids shall remain open for 180 calendar days after the day of the bid opening, but the City may, at its sole discretion, release any bid and return the bid Security prior to that date.

Extensions of time when bids shall remain open beyond the 180 day period may be made only by mutual written agreement between the City, the successful Bidder and the surety, if any, for the successful Bidder.

1.9 LATE BIDS OR MODIFICATIONS

Only bids received as of the opening date and time will be considered timely. Bids and modifications received after the time set for the opening will be returned un-opened to the sender and rejected as late.

1.10 CONFLICTS WITHIN THE SOLICITATION

Where there appears to be a conflict between the General Terms and Conditions, Special Conditions, the Technical Specifications, the SOLICITATION Submittal Section, or any addendum issued, the order of precedence shall be the last addendum issued, the SOLICITATION Submittal Section, the Technical Specifications, the Special Conditions, and then the General Terms and Conditions.

1.11 CLARIFICATION OR OBJECTION TO BID SPECIFICATIONS

If any person contemplating submitting a bid for this contract is in doubt as to the true meaning of the specifications or other SOLICITATION documents or any part thereof, they may submit requests for clarification to the Procurement Services Division on or before the date specified for a request for clarification. All such requests for clarification shall be made in writing and the person submitting the request will be responsible for its prompt delivery. Any interpretation of the SOLICITATION, if made, will be made only by Addendum duly issued. A copy of such Addendum will be made available to each person receiving a Solicitation. The City will not be responsible for any other explanation or interpretation of the SOLICITATION given prior to the award of the contract. Any objection to the specifications and requirements as set forth in this SOLICITATION must be filed in writing with the Chief Procurement Officer on or before the date specified for a request for clarification.

1.12 COMPETENCY OF PROPOSERS

Pre-award inspection of the Bidder's facility may be made prior to the award of a contract. Bids will be considered only from firms which are regularly engaged in the business of providing the goods and/or services as described in this SOLICITATION(s); have a record of performance for a reasonable period of time; and have sufficient financial support, equipment and organization to ensure that they can satisfactorily deliver the material and/or services if awarded a Contract under the terms and conditions herein stated. The terms "equipment and organization" as used herein shall be construed to mean a fully equipped and well established company in line with the best business practices in the industry and as determined by the proper authorities of the City.

The City may consider any evidence available to it of the financial, technical and other qualifications and abilities of a proposer, including past performance (experience) in making the award in the best interest of the City. In all cases the City of Hollywood shall have no liability to any proposer for any costs or expense incurred in connection with this SOLICITATION or otherwise.

1.13 QUALIFICATIONS OF PROPOSERS

No Bid will be accepted from, nor will any contract be awarded to any person who is in arrears to the City upon any debt or contract, or who is a defaulter, as surety or otherwise, upon any obligation to City, or who is deemed responsible or unreliable by the City.

As part of the bid evaluation process, City may conduct a background investigation including a record check by the Hollywood Police Department. Proposer's submission of a bid constitutes acknowledgment of the process and consent to such investigation. City shall be the sole judge in determining a Bidder's qualifications.

1.14 CONSIDERATION OF BIDS

In cases where an item requested is identified by a manufacturer's name, trade name, catalog number, or reference, it is understood that the Vendor proposes to furnish the item so identified and does not propose to furnish an "equal" unless the proposed "equal" is pre-approved by the City.

References to any of the above are intended to be descriptive but not restrictive and only indicate articles that will be satisfactory. A bid of an "equal" will be considered, provided that the Vendor states in his bid exactly what he proposes to furnish, including sample, illustration, or other descriptive matter which will clearly indicate the character of the article covered by such bid. The designated City representative hereby reserves the right to approve as an "equal", or to reject as not being an "equal", any article proposed which contains major or minor variations from specifications requirements.

1.15 AWARD OF CONTRACT

If the Contract is to be awarded, it will be awarded, after evaluation by the City, to the responsible and responsive Proposer whom the City determines will be in the best interests of the City and not necessarily to the lowest cost Proposer. Proposers may be invited to an oral interview before the committee. A short list of finalists will be determined and presented to either the City Manager or his/her designee or to the City Commission, in accordance with the applicable City of Hollywood Code of Ordinances, and will make the final ranking for the purposes of negotiating a contract with the top ranked firm. The successful Proposer shall be required to sign a negotiated contract; the refusal or failure of a successful Proposer to execute a contract which contains the mandatory material terms and conditions contained in the SOLICITATION, shall be grounds for deeming the Proposer and/or the Proposer's bid/proposal non-responsive.

If applicable, the Proposer to whom award is made shall execute a written contract prior to award by the City Commission. If the Proposer to whom the first award is made fails to enter into a contract as herein provided, the Contract may be let to the next highest ranked Proposer who is responsible and responsive in the opinion of the City.

1.16 BASIS FOR AWARD, EVALUATION CRITERIA AND QUESTIONS

The qualification of bid/proposal responders on this project will be considered in making the award. The City is not obligated to accept any bid/proposal if deemed not in the best interest of the City to do so. The City shall make award to a qualified proposer based on fees submitted and responses to this SOLICITATION.

Failure to include in the bid all information outlined herein may be cause for rejection of the bid.

The City reserves the right to accept or reject any and all bids, in whole or in part, as determined to be in the best interest of the City in its sole discretion.

The City reserves the right to waive any informalities or irregularities in bids.

The City reserves the right to negotiate separately the terms and conditions or all or any part of the bids as deemed to be in the City's best interest in its sole discretion.

Information and/or factors gathered during interviews, negotiations and any reference checks, and any other information or factors deemed relevant by the City, shall be utilized in the final award. The final award of a contract is subject to approval by the City Commission.

1.17 AGREEMENT

An agreement shall be sent to the awarded proposer to be signed, witnessed, and returned to the City for execution. The City will provide a copy of the fully executed agreement to the awarded proposer.

1.18 NOTICE TO PROCEED

A signed purchase order, blanket purchase order or fully executed agreement will be the Proposer's authorization to proceed and may substitute for a "Notice to Proceed" form.

1.19 BID PROTESTS

The City shall provide notice of its intent to award or reject to all Proposers by posting such notice on the City's website.

After a notice of intent to award a contract is posted, any actual or prospective proposer who is aggrieved in connection with the pending award of the contract or any element of the process leading to the award of the contract may protest to the Director of Procurement Services. A protest must be filed within five business days after posting or any right to protest is forfeited. The protest must be in writing, must identify the name and address of the protester, and must include a factual summary of, and the basis for, the protest. Filing shall be considered complete when the protest, including a deposit, is received by the Procurement Services Division. Failure to file a protest within the time-frame specified herein shall constitute a full waiver of all rights to protest the City's decision regarding the award.

The written protest shall state in detail the specific facts and law or ordinance upon which the protest of the proposed award is based, and shall include all pertinent documents.

A written protest may not challenge the relative weight of evaluation criteria or a formula for assigning points.

Upon receipt of a formal written protest, the City shall stop award proceedings until resolution of the protest; unless it has been determined that the award of the contract without delay is necessary to protect substantial interests of the City.

Any and all costs incurred by a protesting party in connection with a bid protest shall be the sole responsibility of the protesting party.

Upon receipt of a protest of the pending award of a contract, a copy of the protest shall promptly be forwarded to the City Attorney. The City Attorney shall thereupon review the charge to determine its sufficiency, including whether the protest was timely filed. If upon review the City Attorney determines that the charge is insufficient, the City Attorney may issue a

summary dismissal of the protest. If upon review the City Attorney determines that the charge is sufficient, a hearing of the protest committee shall be scheduled.

A protest committee shall have the authority to review, settle and resolve the protest. The committee shall consist of three members appointed by the City Manager. The committee's review shall be informal.

If the protest committee determines that the pending award of a contract or any element of the process leading to the award involved a significant violation of law or applicable rule or regulation, all steps necessary and proper to correct the violation shall be taken. If the committee determines that the protest is without merit,

The Director shall promptly issue a decision in writing stating the reason for the decision and furnish a copy to the protester and any other interested party, and the process leading to the award shall proceed.

1.20 REQUIREMENTS FOR SIGNING BIDS/PROPOSALS

Requirements for Signing Bid/Proposal:

A. The bid/proposal must be signed in ink by an individual authorized to legally bind the person, partnership, company, or corporation submitting the bid/proposal. In cases where the bid/proposal is signed by a deputy or subordinate, the principal's proper written grant of authority to such deputy or subordinate must accompany the bid/proposal.

B. Bids/proposals by corporations must be executed in the corporate name by the President or other corporate officers accompanied by evidence of authority to sign. The corporate address and state of incorporation must be shown below the signature.

C. Bids/proposals by partnerships must be executed in the partnership name and signed by a general partner whose title must appear under the signature and the official address of the partnership must be shown below the signature.

D. All manual signatures must have the name typed directly under the line of the signature

E. The above requirements apply to all SOLICITATION addenda.

1.21 EXAMINATION OF BID DOCUMENTS

Before submitting a bid, each Bidder must: examine the bid Documents thoroughly; consider federal, state and local laws, ordinances, rules and regulations that may in any manner affect cost, progress, performance, or provision of the commodities and/or services; study and carefully correlate Proposer's observations with the bid Documents, and notify the City's agent of all conflicts, errors and discrepancies in the bid Documents.

The submission of a bid/proposal will constitute an incontrovertible representation by the Bidder, that the Bidder has complied with every requirement of this SOLICITATION, that without exception, the bid is premised upon performing the services and/or furnishing the commodities and materials in accordance with such means, methods, techniques, sequences or procedures as may be indicated in or required by the bid/proposal Documents, and that the bid Documents are sufficient in scope and detail to indicate and convey understanding of all terms and conditions of performance and furnishing of the goods and/or services.

1.22 PUBLIC RECORDS LAW

If applicable, for each public agency contract for services, the Proposer is required to comply with F.S. 119.0701, which includes the following:

A. Keep and maintain public records that ordinarily and necessarily would be required by the public agency in order to perform the service.

B. Provide the public with access to public records on the same terms and conditions that the public agency would provide the records and at a cost that does not exceed the cost provided in F.S. Chapter 119 or as otherwise provided by law.

C. Ensure that public records that are exempt or confidential and exempt from public records disclosure requirements are not disclosed except as authorized by law.

D. Meet all requirements for retaining public records and transfer, at no cost, to the public agency, all public records in possession of the proposer upon termination of the contract and destroy any duplicate public records that are exempt or confidential and exempt from public records disclosure requirements. All records stored electronically must be provided to the public agency in a format that is compatible with the information technology systems of the public agency.

Public records may be inspected and examined by anyone desiring to do so, at a reasonable time, under reasonable conditions, and under supervision by the custodian of the public record. Sealed Bids become subject to the public records disclosure requirements of F.S. Chapter 119, notwithstanding a proposers' request to the contrary, at the time the City provides notice of a decision or intended decision, or 30 days after the bid/proposal opening, whichever is earlier.

Financial statements submitted in response to a request by the City may be confidential and exempt from disclosure.

Data processing software obtained under a licensing agreement which prohibits its disclosure may also exempt.

Proposers are hereby notified and agree that all information submitted as part of, or in support of SOLICITATION submittals will be available for public inspection after opening of SOLICITATION in compliance with Chapter 119 of the Florida Statutes. The proposer shall not, unless required as part of this SOLICITATION, submit any information in response to this invitation which the proposer considers to be a trade secret, proprietary or confidential. The submission, not required as part of this this SOLICITATION, of any information to the City in connection with this invitation shall be deemed conclusively to be a waiver of any trade secret or other protection, which would otherwise be available to the proposer.

1.23 INFORMATION

For information concerning procedure for responding to this Solicitation (SOLICITATION), contact the Point of Contact in the Section 1.4. Such contact shall be for clarification purposes only. **It is preferred that all other questions be submitted in writing via OpenGov at least 10 calendar days prior to the bid/proposal due/opening date.**

1.24 N/A – INTENTIONALLY OMITTED

1.25 MODIFICATION AND WITHDRAWAL OF BIDS/PROPOSALS

Bids must be modified or withdrawn by an appropriate document duly executed in the manner that a bid must be executed and delivered to the place where bids are to be submitted at any time prior to the deadline for submitting bids. A request for withdrawal or a modification must be in writing and signed by a person duly authorized to do so and, in a case where signed by a deputy or subordinate, the principal's proper written grant of authority to such deputy or subordinate must accompany the request for withdrawal or modification. Withdrawal of a bid will not prejudice the rights of a Bidder to submit a new bid prior to the bid date and time. Except where provided in the following paragraph no bid may be withdrawn or modified after expiration of the period for receiving bids.

If, within twenty-four (24) hours after bids are opened, any Bidder files a duly signed written notice with the City and within five (5) calendar days thereafter demonstrates to the reasonable satisfaction of the City by clear and convincing evidence that there was a material and substantial mistake in the preparation of its bid, or that the mistake is clearly evident on the face of the bid but the intended correct bid is not similarly evident, then the Bidder may withdraw its bid and the bid Security will be returned.

1.26 N/A – INTENTIONALLY OMITTED

1.27 OPEN END CONTRACT

No guarantee is expressed or implied as to the total quantity of commodities/services to be purchased under any open end contract. Estimated quantities will be used for bid comparison purposes only. The City reserves the right to issue purchase orders as and when required, or a blanket purchase order and release partial quantities as and when required or any combination of the preceding.

ORDERING: The CITY reserves the right to purchase commodities/services specified herein through Contracts established by other governmental agencies or through separate procurement actions due to unique or special needs. If an urgent

delivery is required within a period shorter than the delivery time specified in the contract, and if the seller is unable to comply therewith, the City reserves the right to obtain such delivery from others without penalty or prejudice to the City or to the Bidder.

1.28 AUDIT RIGHTS

The City reserves the right to audit the records of the successful Bidder for the commodities and/or services provided under the Contract at any time during the performance and term of the Contract and for a period of three (3) years after completion and acceptance by the City. If required by the City, the successful Bidder agrees to submit to an audit by an independent certified public accountant selected by the City. The successful Bidder shall allow the City to inspect, examine and review the records of the successful Bidder in relation to this contract at any and all times during normal business hours during the term of the Contract.

1.29 LOCAL, STATE AND FEDERAL COMPLIANCE REQUIREMENTS

The Bidder shall comply with all local, state and federal directives, orders and laws as applicable to this SOLICITATION and subsequent contract(s) including, but not limited to:

A. Equal Employment Opportunity (EEO), in compliance with Executive Order 11246 as amended and applicable to this contract.

B. All manufactured items and fabricated assemblies shall comply with applicable requirements of the Occupation Safety and Health Act of 1970 as amended, and be in compliance with Chapter 442, Florida Statutes. Any toxic substance listed in Section 38F-41.03 of the Florida Administrative Code delivered as a result of this order must be accompanied by a completed Material Safety Data Sheet (MSDS).

C. The Immigration and Nationality Act prohibits (i) the employment of an unauthorized alien when the employer knows the individual is an unauthorized alien and (ii) the employment of an individual without complying with the requirements of the federal employment verification system. If a proposer commits either of these violations, such violation shall be cause for unilateral cancellation of the contract.

D. This Section applies only to any contract for goods or services of $1 million or more: The Proposer certifies that it is not on the Scrutinized Companies with Activities in Sudan List or the Scrutinized Companies with Activities in the Iran Petroleum Energy Sector List and that it does not have business operations in Cuba or Syria as provided in section 287.135, Florida Statutes (2011), as may be amended or revised. The City may terminate this Contract at the City's option if the Proposer is found to have submitted a false certification as provided under subsection (5) of section 287.135, Florida Statutes (2011), as may be amended or revised, or been placed on the Scrutinized Companies with Activities in Sudan List or the Scrutinized Companies with Activities in the Iran Petroleum Energy Sector List or has engaged in business operations in Cuba or Syria, as defined in Section 287.135, Florida Statutes (2011), as may be amended or revised.

1.30 FRAUD AND MISREPRESENTATION

Any individual, corporation or other entity that attempts to meet its contractual obligations with the City through fraud, misrepresentation or material misstatement, may be debarred from doing business with the City. The City as further sanction may terminate or cancel any other contracts with such individual, corporation or entity. Such individual or entity shall be responsible for all direct or indirect costs associated with termination or cancellation, including attorney's fees.

1.31 DEBARRED OR SUSPENDED BIDDERS

The bidder certifies, by submission of a response to this solicitation, that neither it nor its principals and sub bidder are presently debarred or suspended by any Federal department or agency.

1.32 COLLUSION

More than one bid/proposal received for the same work from an individual, firm, partnership, corporation or association under the same or different names will not be considered. Reasonable grounds for believing that any Bidder is interested in more than one bid for the same work will cause the rejection of such bid which the Bidder is interested. If there are reasonable grounds for believing that collusion exists among the Bidder, the bids of participants in such collusion will not be considered.

1.33 COPELAND "ANTI-KICKBACK"

The Bidder and all sub bidders will comply with the Copeland Anti-Kickback Act (18 U.S.C. 874) as supplemented in Department of Labor regulations (29 CFR Part 3).

1.34 FORCE MAJEURE

The Agreement which is awarded to the successful proposer may provide that the performance of any act by the City or Bidder hereunder may be delayed or suspended at any time while, but only so long as, either party is hindered in or prevented from performance by acts of God, the elements, war, rebellion, strikes, lockouts or any cause beyond the reasonable control of such party, provided however, the City shall have the right to provide substitute service from third parties or City forces and in such event the City shall withhold payment due the Bidder for such period of time. If the condition of force majeure exceeds a period of 14 days the City may, at its option and discretion, cancel or renegotiate this Agreement.

1.35 PUBLIC ENTITY CRIMES

A person or affiliate who has been placed on the convicted vendor list following a conviction for a public entity crime may not submit a bid on a contract to provide any goods or services to a public entity, may not submit a bid on a contract with a public entity for the construction or repair of a public building or public work, may not submit bids on leases of real property to a public entity, may not be awarded or perform work as a Bidder, supplier, sub bidder, or consultant under a contract with any public entity, and may not transact business with any public entity in excess of the threshold amount provided in Florida Statutes, Section 287.017, for CATEGORY TWO for a period of 36 months from the date of being placed on the convicted vendor list.

1.36 DRUG-FREE WORKPLACE PROGRAM

Preference shall be given to businesses with drug-free workplace programs. Whenever two or more bids which are equal with respect to price, quality, and service are received by the State or by any political subdivision for the procurement of commodities or contractual services, a bid received from a business that certifies that it has implemented a drug-free workplace program shall be given preference in the award process. Established procedures for processing tie bids will be followed if none of the tied vendors have a drug-free workplace program.

1.37 SOLICITATION, GIVING, AND ACCEPTANCE OF GIFTS POLICY

Bidder shall sign and submit the attached form indicating understanding and compliance with the City's and State's policies prohibiting solicitation and acceptance of gifts by public officers, employees and candidates. Failure to submit the signed form will result in your bid being declared non-responsive; provided, however, that a responsible Bidder whose bid would be responsive but for the failure to submit the signed form in its bid may be given the opportunity to submit the form to the City within five calendar days after notification by the City, if this is determined to be in the best interest of the City.

1.38 CONFLICT OF INTEREST

The Bidder represents that:

No officer, director, employee, agent, or other consultant of the City or a member of the immediate family or household of the aforesaid has directly or indirectly received or been promised any form of benefit, payment or compensation, whether tangible or intangible, in connection with the grant of this Agreement.

There are no undisclosed persons or entities interested with the Proposer in this Agreement. This Agreement is entered into by the Proposer without any connection with any other entity or person making a bid Bidder for the same purpose, and without collusion, fraud or conflict of interest. No elected or appointed officer or official, director, employee, agent or other consultant of the City, or of the State of Florida (including elected and appointed members of the legislative and executive branches of government), or member of the immediate family or household of any of the aforesaid:

1. Is interested on behalf of or through the Bidder directly or indirectly in any manner whatsoever in the execution or the performance of this Agreement, or in the services, supplies or work, to which this Agreement relates or in any portion of the revenues; or

2. Is an employee, agent, advisor, or consultant to the Proposer or to the best of the Proposer's knowledge, any sub bidder or supplier to the Bidder.

Neither the Bidder nor any officer, director, employee, agent, parent, subsidiary, or affiliate of the Bidder shall have an interest which is in conflict with the Bidder's faithful performance of its obligations under this Agreement; provided that the City, in its sole discretion, may consent in writing to such a relationship, and provided the Bidder provides the City with a written notice, in advance, which identifies all the individuals and entities involved and sets forth in detail the nature of the relationship and why it is in the City's best interest to consent to such relationship.

The provisions of this Article are supplemental to, not in lieu of, all applicable laws with respect to conflict of interest. In the event there is a difference between the standards applicable under this Agreement and those provided by statute, the stricter standard shall apply.

In the event the Bidder has no prior knowledge of a conflict of interest as set forth above and acquires information which may indicate that there may be an actual or apparent violation of any of the above, the Bidder shall promptly bring such information to the attention of the City's ENGINEER. The Bidder shall thereafter cooperate with the City's review and investigation of such information, and comply with the instructions the Bidder receives from the ENGINEER in regard to remedying the situation.

1.39 DISCRIMINATION

Any entity or affiliate who has been placed on the discriminatory vendor list may not submit a bid on a contract to provide goods or services to a public entity, may not submit a bid on a contract with a public entity for construction or repair of a public building or public work, may not submit bids on leases of real property to a public entity, may not award or perform work as a proposer, supplier, sub bidder, or consultant under contract with any public entity, and may not transact business with any public entity.

1.40 ADVICE OF OMISSION OR MISSTATEMENT

In the event it is evident to a Vendor responding to this SOLICITATION that the City has omitted or misstated a material requirement to this SOLICITATION and/or the services required by this SOLICITATION, the responding Vendor shall advise the contact identified in the SOLICITATION Clarifications and Questions section above of such omission or misstatement.

1.41 CONFIDENTIAL INFORMATION

Information contained in the Vendor's bid that is company confidential must be clearly identified in the bid/proposal itself. The City will be free to use all information in the Vendor's bid for the City's purposes, in accordance with State Law. Vendor bids shall remain confidential for 30 days or until a notice of intent to award is posted, which is sooner. The Vendor understands that any material supplied to the City may be subject to public disclosure under the Public Records Law.

1.42 GOVERNING LAW

This Contract, including appendices, and all matters relating to this Contract (whether in contract, statute, tort (such as negligence), or otherwise) shall be governed by, and construed in accordance with, the laws of the State of Florida. This shall apply notwithstanding such factors which include, but are not limited to, the place where the contract is entered into, the place where the accident occurs and not withstanding application of conflicts of law principles.

1.43 LITIGATION VENUE

The parties waive the privilege of venue and agree that all litigation between them in the state courts shall take place in Broward County, Florida and that all litigation between them in the federal courts shall take place in the Southern District of Florida.

1.44 SOVEREIGN IMMUNITY

Nothing in this agreement shall be interpreted or construed to mean that the city waives its common law sovereign immunity or the limits of liability set forth in Section 768.28, Florida Statute.

1.45 SURVIVAL

The parties acknowledge that any of the obligations in this Agreement will survive the term, termination and cancellation hereof. Accordingly, the respective obligations of the Proposer and the City under this Agreement, which by nature would continue beyond the termination, cancellation or expiration thereof, shall survive termination, cancellation or expiration hereof.

1.46 INDEMNIFICATION AND HOLD HARMLESS AGREEMENT

The Contractor shall indemnify and hold harmless the City of Hollywood and its officers, employees, agents and instrumentalities from any and all liability, losses or damages. In addition, the City shall be entitled to attorney's fees and costs of defense, which the City of Hollywood, or its officers, employees, agents or instrumentalities may incur as a result of claims, demands, suits, causes of actions or proceedings of any kind or nature arising out of, relating to or resulting from the performance of this project by the awarded Bidder or its employees, agents, servants, partners, principals or subcontractors. Furthermore, the awarded Bidder shall pay all claims and losses in connection therewith and shall investigate and defend all claims, suits or actions of any kind of nature in the name of the City of Hollywood, where applicable, including appellate proceedings, and shall pay all costs, judgments, and attorney's fees which may issue thereon. The awarded Bidder expressly understands and agrees that any insurance protection required by the resulting agreement or otherwise provided by the awarded Bidder shall cover the City of Hollywood, its officers, employees, agents and instrumentalities and shall include claims for damages resulting from and/or caused by the negligence, recklessness or intentional wrongful misconduct of the Contractor and persons employed by or utilized by the Contractor in the performance of the contract.

1.47 PATENT AND COPYRIGHT INDEMNIFICATION

The Bidder warrants that all deliverables furnished hereunder, including but not limited to: services, equipment programs, documentation, software, analyses, applications, methods, ways, processes, and the like, do not infringe upon or violate any patent, copyrights, service marks, trade secret, or any other third party proprietary rights.

The Bidder shall be liable and responsible for any and all claims made against the City for infringement of patents, copyrights, service marks, trade secrets or any other third party proprietary rights, by the use or supplying of any programs, documentation, software, analyses, applications, methods, ways, processes, and the like, in the course of performance or completion of, or in any way connected with, the work, or the City's continued use of the deliverables furnished hereunder. Accordingly, the Bidder, at its own expense, including the payment of attorney's fees, shall indemnify, and hold harmless the City and defend any action brought against the City with respect to any claim, demand, and cause of action, debt, or liability.

In the event any deliverable or anything provided to the City hereunder, or a portion thereof, is held to constitute an infringement and its use is or may be enjoined, the Bidder shall have the obligation, at the City's option, to (i) modify, or require that the applicable sub bidder or supplier modify, the alleged infringing item(s) at the Bidder's expense, without impairing in any respect the functionality or performance of the item(s), or (ii) procure for the City, at the Bidder 's expense, the rights provided under this Agreement to use the item(s).

The Bidder shall be solely responsible for determining and informing the City whether a prospective supplier or sub bidder is a party to any litigation involving patent or copyright infringement, service mark, trademark, violation, or proprietary rights claims or is subject to any injunction which may prohibit it from providing any deliverable hereunder. The Bidder shall enter into agreements with all suppliers and sub bidder at the Bidder 's own risk. The City may reject any deliverable that it believes to be the subject of any such litigation or injunction, or if, in the City's judgment, use thereof would delay the work or be unlawful.

The Bidder shall not infringe any copyright, trademark, service mark, trade secrets, patent rights, or other intellectual property rights in the performance of the work.

1.48 ADVERTISING

Vendor shall not advertise or publish the fact that the City has placed this order without prior written consent from the City, except as may be necessary to comply with a proper request for information from an authorized representative of a governmental unit or agency.

1.49 DISCLAIMER

The Hollywood may, in its sole discretion, accept or reject, in whole or in part, for any reason whatsoever any or all bids; re-advertise this SOLICITATION, postpone or cancel at any time this SOLICITATION process; or, waive any formalities of or irregularities in the bid process. Bids that are not submitted on time and/or do not conform to the City of Hollywood's requirements will not be considered. After all bids are analyzed, organization(s) submitting bid that appear, solely in the opinion of the City of Hollywood, to be the most competitive, shall be submitted to the City of Hollywood's City Commission, and the final selection will be made shortly thereafter with a timetable set solely by the City of Hollywood. The selection by the City of Hollywood shall be based on the bid, which is, in the sole opinion of the City Commission of the City of Hollywood, in the best interest of the City of Hollywood. The issuance of this SOLICITATION constitutes only an invitation to make a bid to the City of Hollywood. The City of Hollywood reserves the right to determine, in its sole discretion, whether any aspect of the bid satisfies the criteria established by the City. In all cases the City of Hollywood shall have no liability to any proposer for any costs or expense incurred in connection with this bid or otherwise.

1.50 TRADEMARKS

The City warrants that all trademarks the City requests the Vendor to affix to articles purchased are those owned by the City and it is understood that the Vendor shall not acquire or claim any rights, title, or interest therein, or use any of such trademarks on any articles produced for itself or anyone other than the City.

1.51 RIGHT TO REQUEST ADDITIONAL INFORMATION

The City reserves the right to request any additional information that might be deemed necessary during the evaluation process.

1.52 BID PREPARATION COSTS

The Vendor is responsible for any and all costs incurred by the Vendor or his/her sub bidders in responding to this solicitation.

1.53 DESIGN COSTS (N/A)

1.54 ADDITIONAL CHARGES

No additional charges, other than those listed on the price breakdown sheets, shall be made. Prices quoted will include verification/coordination of order, all costs for shipping, delivery to all sites, unpacking, setup, installation, operation, testing, cleanup, training and Vendor travel charges.

1.55 RIGHTS TO PERTINENT MATERIALS

All responses, inquires, and correspondence relating to this SOLICITATION and all reports, charts, displays, schedules, exhibits and other documentation produced by the Vendor that are submitted as part of the bid shall become the property of the City upon receipt, a part of a public record upon opening, and will not be returned.

1.56 INSURANCE REQUIREMENTS

See insurance requirements in the main solicitation document.

1.57 NATURE OF THE AGREEMENT

The Agreement incorporates and includes all negotiations, correspondence, conversations, agreements, and understandings applicable to the matters contained in the Agreement. The parties agree that there are no commitments, agreements, or understandings concerning the subject matter of the Agreement that are not contained in the Agreement, and that the Agreement contains the entire agreement between the parties as to all matters contained herein. Accordingly, it is agreed that no deviation from the terms hereof shall be predicated upon any prior representations or agreements, whether oral or written. It is further agreed that any oral representations or modifications concerning this Agreement shall be of no force or effect, and that the Agreement may be modified, altered or amended only by a written amendment duly executed by both parties hereto or their authorized representatives.

The Bidder shall provide the services set forth in the Scope of Services, and render full and prompt cooperation with the City in all aspects of the services performed hereunder.

The Bidder acknowledges that the Agreement requires the performance of all things necessary for or incidental to the effective and complete performance of all work and services under this Contract. All things not expressly mentioned in the Agreement but necessary to carrying out its intent are required by the Agreement, and the Bidder shall perform the same as though they were specifically mentioned, described and delineated.

The Bidder shall furnish all labor, materials, tools, supplies, and other items required to perform the work and services that are necessary for the completion of this Contract. All work and services shall be accomplished at the direction of and to the satisfaction of the City's ENGINEER.

The Bidder acknowledges that the City shall be responsible for making all policy decisions regarding the Scope of Services. The Proposer agrees to provide input on policy issues in the form of recommendations.

The Bidder agrees to implement any and all changes in providing services hereunder as a result of a policy change implemented by the City. The Bidder agrees to act in an expeditious and fiscally sound manner in providing the City with input regarding the time and cost to implement said changes and in executing the activities required to implement said changes

1.58 AUTHORITY OF THE CITY'S ENGINEER

The Bidder hereby acknowledges that the City's ENGINEER will determine in the first instance all questions of any nature whatsoever arising out of, under, or in connection with, or in any way related to or on account of, this Agreement including without limitations: questions as to the value, acceptability and fitness of the services; questions as to either party's fulfillment of its obligations under the Contract; negligence, fraud or misrepresentation before or subsequent to acceptance of the Bid; questions as to the interpretation of the Scope of Services; and claims for damages, compensation and losses.

The Bidder shall be bound by all determinations or orders and shall promptly obey and follow every order of the ENGINEER, including the withdrawal or modification of any previous order and regardless of whether the Bidder agrees with the ENGINEER's determination or order. Where orders are given orally, they will be issued in writing by the ENGINEER as soon thereafter as is practicable.

The Bidder must, in the final instance, seek to resolve every difference concerning the Agreement with the ENGINEER. In the event that the ENGINEER and the Bidder are unable to resolve their difference, the Bidder may initiate a dispute in accordance with the procedures set forth in the section below. Exhaustion of these procedures shall be a condition precedent to any lawsuit permitted hereunder.

In the event of such dispute, the parties to this Agreement authorize the City Manager or designee, who may not be the ENGINEER or anyone associated with this Project, acting personally, to decide all questions arising out of, under, or in connection with, or in any way related to or on account of the Agreement (including but not limited to claims in the nature of breach of contract, fraud or misrepresentation arising either before or subsequent to execution hereof) and the decision of each with respect to matters within the City Manager's purview as set forth above shall be conclusive, final and binding on the parties. Any such dispute shall be brought, if at all, before the City Manager within 10 days of the occurrence, event or act out of which the dispute arises.

The City Manager may base this decision on such assistance as may be desirable, including advice of experts, but in any event shall base the decision on an independent and objective determination of whether the Bidder's performance or any deliverable meets the requirements of this Agreement and any specifications with respect thereto set forth herein. The effect of any decision shall not be impaired or waived by any negotiations or settlements or offers made in connection with the dispute, whether or not the City Manager participated therein, or by any prior decision of others, which prior decision shall be deemed subject to review, or by any termination or cancellation of the Agreement. All such disputes shall be submitted in writing by the Bidder to the City Manager for a decision, together with all pertinent information in regard to such questions, in order that a fair and impartial decision may be made. The parties agree that whenever the City Manager is entitled to exercise discretion or judgment or to make a determination or form an opinion pursuant to the provisions of this Article, such action shall be deemed fair and impartial when exercised or taken. The City Manager shall render a decision in writing and deliver a copy of the same to the Bidder. Except as such remedies may be limited or waived elsewhere in the Agreement, the Bidder reserves the right to pursue any remedies available under law after exhausting the provisions of this Article.

1.59 MUTUAL OBLIGATIONS

This Agreement, including attachments and appendices to the Agreement, shall constitute the entire Agreement between the parties with respect hereto and supersedes all previous communications and representations or agreements, whether written or oral, with respect to the subject matter hereof unless acknowledged in writing by the duly authorized representatives of both parties.

Nothing in this Agreement shall be construed for the benefit, intended or otherwise, of any third party that is not a parent or subsidiary of a party or otherwise related (by virtue of ownership control or statutory control) to a party.

In those situations where this Agreement imposes an indemnity or defense obligation on the Bidder, the City may, at its expense, elect to participate in the defense if the City should so choose. Furthermore, the City may at its own expense defend or settle any such claims if the Bidder fails to diligently defend such claims, and thereafter seek indemnity for costs and attorney's fees from the Bidder.

1.60 SUBCONTRACTUAL RELATIONS

If the Bidder will cause any part of this Agreement to be performed by a sub bidder, the provisions of this Contract will apply to such sub bidder and its officers, agents and employees in all respects as if it and they were employees of the Proposer; and the Proposer will not be in any manner thereby discharged from its obligations and liabilities hereunder, but will be liable hereunder for all acts and negligence of the sub bidder, its officers, agents, and employees, as if they were employees of the Proposer. The services performed by the sub bidder will be subject to the provisions hereof as if performed directly by the Bidder.

The Bidder, before making any subcontract for any portion of the services, will state in writing to the City the name of the proposed sub bidder, the portion of the services which the sub bidder is to do, the place of business of such sub bidder, and such other information as the City may require. The City will have the right to require the Bidder not to award any subcontract to a person, firm or corporation disapproved by the City.

Before entering into any subcontract hereunder, the Bidder will inform the sub bidder fully and completely of all provisions and requirements of this Agreement relating either directly or indirectly to the services to be performed. Such services performed by such sub bidder will strictly comply with the requirements of this Contract.

In order to qualify as a sub bidder satisfactory to the City, in addition to the other requirements herein provided, the sub bidder must be prepared to prove to the satisfaction of the City that it has the necessary facilities, skill and experience, and ample financial resources to perform the services in a satisfactory manner. To be considered skilled and experienced, the sub bidder must show to the satisfaction of the City that it has satisfactorily performed services of the same general type which are required to be performed under this Agreement.

The City shall have the right to withdraw its consent to a subcontract if it appears to the City that the subcontract will delay, prevent, or otherwise impair the performance of the Bidder's obligations under this Agreement. All sub bidder are required to protect the confidentiality of the City and City's proprietary and confidential information. The Bidder shall furnish to the City copies of all subcontracts between the Bidder and sub bidder and suppliers hereunder. Within each such subcontract, there shall be a clause for the benefit of the City permitting the City to request completion of performance by the sub bidder of its obligations under the subcontract, in the event the City finds the Bidder in breach of its obligations, and the option to pay the sub bidder directly for the performance by such sub bidder. The foregoing shall neither convey nor imply any obligation or liability on the part of the City to any sub bidder hereunder as more fully described herein.

1.61 PROMPT PAYMENT: LATE PAYMENTS BY BIDDER TO SUB BIDDER AND MATERIAL SUPPLIERS; PENALTY:

When a Bidder receives from the City of Hollywood any payment for contractual services, commodities, materials, supplies, or construction contracts, the proposer shall pay such moneys received to each sub bidder and material supplier in proportion to the percentage of work completed by each sub bidder and material supplier at the time of receipt. If the Bidder receives less than full payment, then the proposer shall be required to disburse only the funds received on a pro rata basis to the sub bidder and materials Suppliers, each receiving a prorated portion based on the amount due on the payment. If the proposer without reasonable cause fails to make payments required by this section to sub bidder and material suppliers within fifteen (15) working days after the receipt by the Bidder of full or partial payment, the proposer shall pay to the sub bidder and material suppliers a penalty in the amount of one percent (1%) of the amount due, per month, from the expiration of the period allowed herein for payment. Such penalty shall be in addition to actual payments owed. Retainage is also subject to the prompt payment requirement and must be returned to the sub bidder or material

supplier whose work has been completed, even if the prime contract has not been completed. The Bidder shall include the above obligation in each subcontract it signs with a sub bidder or material suppler.

1.62 TERMINATION FOR CONVENIENCE AND SUSPENSION OF WORK

The City may terminate this Agreement if an individual or corporation or other entity attempts to meet its contractual obligation with the City through fraud, misrepresentation or material misstatement.

The City may, as a further sanction, terminate or cancel any other contract(s) that such individual or corporation or other entity has with the City. Such individual, corporation or other entity shall be responsible for all direct and indirect costs associated with such termination or cancellation, including attorney's fees.

The foregoing notwithstanding, any individual, corporation or other entity which attempts to meet its contractual obligations with the City through fraud, misrepresentation or material misstatement may be debarred from City contracting in accordance with the City debarment procedures. The Bidder may be subject to debarment for failure to perform and any other reasons related to the Bidder's breach or failure of satisfactory performance.

In addition to cancellation or termination as otherwise provided in this Agreement, the City may at any time, in its sole discretion, with or without cause, terminate this Agreement by written notice to the Bidder and in such event:

The Bidder shall, upon receipt of such notice, unless otherwise directed by the City:

1. Stop work on the date specified in the notice ("the Effective Termination Date");

2. Take such action as may be necessary for the protection and preservation of the City's materials and property;

3. Cancel orders;

4. Assign to the City and deliver to any location designated by the City any non-cancelable orders for deliverables that are not capable of use except in the performance of this Agreement and which have been specifically developed for the sole purpose of this Agreement and not incorporated in the services;

5. Take no action which will increase the amounts payable by the City under this Agreement.

In the event that the City exercises its right to terminate this Agreement pursuant to this Article, the Bidder will be compensated as stated in the payment articles herein, for the:

1. Portion of the services completed in accordance with the Agreement up to the Effective Termination Date; and

2. Non-cancelable deliverables that are not capable of use except in the performance of this Agreement and which have been specifically developed for the sole purpose of this Agreement but not incorporated in the services.

All compensation pursuant to this Article is subject to audit.

1.63 EVENT OF DEFAULT

An Event of Default shall mean a breach of this Agreement by the Bidder. Without limiting the generality of the foregoing and in addition to those instances referred to herein as a breach, an Event of Default, shall include the following:

1. The Bidder has not delivered deliverables on a timely basis;

2. The Bidder has refused or failed, except in any case for which an extension of time is provided, to supply enough properly skilled staff personnel;

3. The Bidder has failed to make prompt payment to sub bidder or suppliers for any services;

4. The Bidder has become insolvent (other than as interdicted by the bankruptcy laws), or has assigned the proceeds received for the benefit of the Bidder 's creditors, or the Bidder has taken advantage of any insolvency statute or debtor/creditor law or if the Bidder 's affairs have been put in the hands of a receiver;

5. The Bidder has failed to obtain the approval of the City where required by this Agreement;

6. The Bidder has failed to provide "adequate assurances" as required under subsection "B" below; and

7. The Bidder has failed in the representation of any warranties stated herein.

When, in the opinion of the City, reasonable grounds for uncertainty exist with respect to the Proposer's ability to perform the services or any portion thereof, the City may request that the Proposer, within the time frame set forth in the City's request, provide adequate assurances to the City, in writing, of the Proposer's ability to perform in accordance with terms of this Agreement. Until the City receives such assurances the City may request an adjustment to the compensation received by the Proposer for portions of the services which the Proposer has not performed. In the event that the Proposer fails to provide to the City the requested assurances within the prescribed time frame, the City may:

1. Treat such failure as a repudiation of this Agreement;

2. Resort to any remedy for breach provided herein or at law, including but not limited to, taking over the performance of the services or any part thereof either by itself or through others.

In the event the City shall terminate this Agreement for default, the City or its designated representatives may immediately take possession of all applicable equipment, materials, products, documentation, reports and data.

1.64 REMEDIES IN THE EVENT OF DEFAULT

If an Event of Default occurs, the Proposer shall be liable for all damages resulting from the default, including but not limited to:

A. Lost revenues;

B. The difference between the cost associated with procuring services hereunder and the amount actually expended by the City for procurement of services, including procurement and administrative costs; and,

C. Such other damages that the City may suffer.

The Proposer shall also remain liable for any liabilities and claims related to the Proposer’s default. The City may also bring any suit or proceeding for specific performance or for an injunction.

1.65 BANKRUPTCY

The City reserves the right to terminate this contract if, during the term of any contract the Proposer has with the City, the Proposer becomes involved as a debtor in a bankruptcy proceeding, or becomes involved in a reorganization, dissolution, or liquidation proceeding, or if a trustee or receiver is appointed over all or a substantial portion of the property of the Proposer under federal bankruptcy law or any state insolvency law.

1.66 CANCELLATION FOR UNAPPROPRIATED FUNDS

The obligation of the City for payment to a Proposer is limited to the availability of funds appropriated in a current fiscal period, and continuation of the contract into a subsequent fiscal period is subject to appropriation of funds, **unless otherwise authorized by law.**

1.67 VERBAL INSTRUCTIONS PROCEDURE

No negotiations, decisions, or actions shall be initiated or executed by the Proposer as a result of any discussions with any City employee. Only those communications which are in writing from an authorized City representative may be considered. Only written communications from Proposers, which are signed by a person designated as authorized to bind the Proposer, will be recognized by the City as duly authorized expressions on behalf of the Proposer.

1.68 E-VERIFY

Proposer acknowledges that the City may be utilizing the Proposer's services for a project that is funded in whole or in part by State funds pursuant to a contract between the City and a State agency. The Proposer shall be responsible for complying with the E-Verify requirements in the contract and using the U.S. Department of Homeland Security's E-Verify system to verify the employment of all new employees hired by the Proposer during the Agreement term. The Proposer is also responsible for e-verifying its bidders, if any, pursuant to any agreement between the City and a State Agency, and reporting to the City any required information. The Proposer acknowledges that the terms of this paragraph are material terms, the breach of any of which shall constitute a default under this Agreement.

1.69 BUDGETARY CONSTRAINTS

In the event the City is required to reduce contract costs due to budgetary constraints, all services specified in this document may be subject to a permanent or temporary reduction in budget. In such an event, the total cost for the affected service shall be reduced as required. The Proposer shall also be provided with a minimum 30-day notice prior to any such reduction in budget.

1.70 COST ADJUSTMENTS (As Applicable)

The cost for all items as quoted herein shall remain firm for the first term of the contract. Costs for subsequent years and any extension term years shall be subject to an adjustment only if increases occur in the industry. However, unless very unusual and significant changes have occurred in the industry, such increases shall not exceed 3% per year or, whichever is less, the latest yearly percentage increase in the All Urban Consumers Price Index (CPU-U) (National) as published by the Bureau of Labor Statistics, U.S. Dept. of Labor. The yearly increase or decrease in the CPI shall be that latest index published and available ninety (90) days prior to the end of the contract year than in effect compared to the index for the same month one year prior. Any requested cost increase shall be fully documented and submitted to the City at least ninety (90) days prior to the contract anniversary date. Any approved cost adjustments shall become effective upon the anniversary date of the contract. In the event the CPI or industry costs decline, the City shall have the right to receive from the Proposer a reduction in costs that reflects such cost changes in the industry. The City may, after examination, refuse to accept the adjusted costs if they are not properly documented, increases are considered to be excessive, or decreases are considered to be insufficient. In the event the City does not wish to accept the adjusted costs and the matter cannot be resolved to the satisfaction of the City, the contract can be cancelled by the City upon giving thirty (30) days written notice to the Proposer.

1.71 OSHA STANDARDS

Proposer acknowledges and agrees that as Contractor for the City of Hollywood, Florida, within the limits of the City of Hollywood, Florida, will have the sole responsibility for compliance with all requirements of the Federal Occupational Safety and Health Act of 1970, and all State and local safety and health regulations, and agrees to defend, indemnify and hold harmless the City of Hollywood, Florida, its officials, employees, service providers, and its agents against any and all legal liability or loss the City of Hollywood, Florida may incur due to the Contractor's failure to comply with such act.

END OF SECTION

City of Hollywood
Procurement Services
Steve Stewart, Chief Procurement Officer
2600 Hollywood Boulevard, Hollywood, FL 33020

PROPOSAL DOCUMENT REPORT

IFB No. IFB-051-23-JJ

Southern Regional Wastewater Treatment Plant Oxygenation Flow Distribution Box Odor Control System Replacement.

RESPONSE DEADLINE: June 21, 2023 at 3:00 pm
Report Generated: Wednesday, July 26, 2023

CARDINAL CONTRACTORS, Inc. Proposal

CONTACT INFORMATION

Company:
CARDINAL CONTRACTORS, Inc.

Email:
john.taylor@prim.com

Contact:
JOHN TAYLOR

Address:
13794 NW 4th Street, Suite 200
Sunrise, FL 33325

Phone:
(682) 220-1354

Website:
N/A

Submission Date:
Jun 21, 2023 2:30 PM

ADDENDA CONFIRMATION

Addendum #1
Confirmed Jun 19, 2023 3:29 PM by JOHN TAYLOR

Addendum #2
Confirmed Jun 19, 2023 3:29 PM by JOHN TAYLOR

QUESTIONNAIRE

1. VENDOR REFERENCE FORM*

Please download the below documents, complete, and upload.

- Vendor_Reference_Form.pdf

Vendor_Reference_Form_Fiesta_Village.pdfVendor_Reference_Form_Sawgrass_WWTP.pdfVendor_Reference_Form_Springtree_WWTP.pdf

2. HOLD HARMLESS AND INDEMNITY CLAUSE*

I, an authorized representative, the contractor, shall indemnify, defend and hold harmless the City of Hollywood, its elected and appointed officials, employees and agents for any and all suits, actions, legal or administrative proceedings, claims, damage, liabilities, interest, attorney' s fees, costs of any kind whether arising prior to the start of activities or following the completion or acceptance and in any manner directly or indirectly caused, occasioned or contributed to in whole or in part by reason of any act, error or

omission, fault or negligence whether active or passive by the contractor, or anyone acting under its direction, control, or on its behalf in connection with or incident to its performance of the contract.

Confirmed

3. NON-COLLUSION STATEMENT*

I , being first duly sworn, depose that:

A. He/she is an authorized representative of the Company, the Proposer that has submitted the attached Proposal.

B. He/she has been fully informed regarding the preparation and contents of the attached Proposal and of all pertinent circumstances regarding such Proposal;

C. Such Proposal is genuine and is not a collusion or sham Proposal;

D. Neither the said Proposer nor any of its officers, partners, owners, agents, representatives, employees or parties in interest, including this affiant has in any way colluded, conspired, connived or agreed, directly or indirectly with any other Proposer, firm or person to submit a collusive or sham Proposal in connection with the contractor for which the attached Proposal has been submitted or to refrain from bidding in connection with such contract, or has in any manner, directly or indirectly, sought by agreement or collusion or communication or conference with any other Proposer, firm or person to fix the price or prices, profit or cost element of the Proposal price or the Proposal price of any other Proposer, or to secure an advantage against the City of Hollywood or any person interested in the proposed Contract; and

E. The price or prices quoted in the attached Proposal are fair and proper and are not tainted by any collusion, conspiracy, connivance or unlawful agreement on the part of the Proposer or any of its agents, representatives, owners, employees, or parties in interest, including this affiant.

Confirmed

4. CERTIFICATIONS REGARDING DEBARMENT, SUSPENSION AND OTHER RESPONSIBILITY MATTERS*

The applicant certifies that it and its principals:

A. Are not presently debarred, suspended, proposed for debarment, declared ineligible, sentenced to a denial of Federal benefits by a State or Federal court, or voluntarily excluded from covered transactions by any Federal department or agency;

B. Have not within a three-year period preceding this application been convicted of or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State, or local) transaction or contract under a public transaction, violation of Federal or State antitrust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property;

C. Are not presently indicted for or otherwise criminally or civilly charged by a governmental entity (Federal, State, or local) with commission of any of the offenses enumerated in paragraph (b) of this certification; and

D. Have not within a three-year period preceding this application had one or more public transactions (Federal, State, or local) terminated for cause or default.

Confirmed

5. DRUG-FREE WORKPLACE PROGRAM*

A. IDENTICAL TIE PROPOSALS - Preference shall be given to businesses with drug-free workplace programs. Whenever two or more bids which are equal with respect to price, quality, and service are received by the State or by any political subdivision for the procurement of commodities or contractual services, a bid received from a business that certifies that it has implemented a drug-free workplace program shall be given preference in the award process. Established procedures for processing tie proposals will be followed if none of the tied vendors have a drug-free workplace program. In order to have a drug-free workplace program, a business shall:

1. Publish a statement notifying employees that the unlawful manufacture, distribution, dispensing, possession, or use of a controlled substance is prohibited in the workplace and specifying the actions that will be taken against employees for violations of such prohibition.

2. Inform employees about the dangers of drug abuse in the workplace, the business’s policy of maintaining a drug-free workplace, any available drug counseling, rehabilitation, and employee assistance programs, and the penalties that may be imposed upon employees for drug abuse violations.

3. Give each employee engaged in providing the commodities or contractual services that are under bid a copy of the statement specified in subsection (1).
4. In the statement specified in subsection (1), notify the employee that, as a condition of working on the commodities or contractual services that are under bid, the employee will abide by the terms of the statement and will notify the employer of any conviction of, or plea of guilty or nolo contendere to, any violation of chapter 893 or of any controlled substance law of the United States or any state, for a violation occurring in the workplace no later than five (5) days after such conviction.
5. Impose a sanction on, or require the satisfactory participation in a drug abuse assistance or rehabilitation program (if such is available in the employee's community) by, any employee who is so convicted.
6. Make a good faith effort to continue to maintain a drug-free workplace through implementation of these requirements.

As the person authorized to sign the statement, I certify that this firm complies fully with the above requirements.

Confirmed

6. SOLICITATION, GIVING, AND ACCEPTANCE OF GIFTS POLICY *

Florida Statute 112.313 prohibits the solicitation or acceptance of Gifts. "No Public officer, employee of an agency, local government attorney, or candidate for nomination or election shall solicit or accept anything of value to the recipient, including a gift, loan, reward, promise of future employment, favor, or service, based upon any understanding that the vote, official action, or judgment of the public officer, employee, local government attorney, or candidate would be influenced thereby." The term "public officer" includes "any person elected or appointed to hold office in any agency, including any person serving on an advisory body."

The City of Hollywood/Hollywood CRA policy prohibits all public officers, elected or appointed, all employees, and their families from accepting any gifts of any value, either directly or indirectly, from any contractor, vendor, consultant, or business with whom the City/CRA does business.

The State of Florida definition of "gifts" includes the following:

- Real property or its use,
- Tangible or intangible personal property, or its use,
- A preferential rate or terms on a debt, loan, goods, or services,

- Forgiveness of indebtedness,
- Transportation, lodging, or parking,
- Food or beverage,
- Membership dues,
- Entrance fees, admission fees, or tickets to events, performances, or facilities,
- Plants, flowers or floral arrangements
- Services provided by persons pursuant to a professional license or certificate.
- Other personal services for which a fee is normally charged by the person providing the services.
- Any other similar service or thing having an attributable value not already provided for in this section.

Any contractor, vendor, consultant, or business found to have given a gift to a public officer or employee, or his/her family, will be subject to dismissal or revocation of contract.

As the person authorized to sign the statement, I certify that this firm will comply fully with this policy.

Confirmed

7. Certificate of Insurance*

See requirements in the #SPECIAL TERM AND CONDITIONS section.

Insurance_Cert.pdf

8. PROOF OF SUNBIZ REGISTRATION*

Enter company FEIN to be verified in Sunbiz

80-0388786

Click to Verify *Value will be copied to clipboard*

9. ACKNOWLEDGMENT AND SIGNATURE PAGE

IF CORPORATION - DATE INCORPORATED/ORGANIZED:*
11/19/2003

STATE INCORPORATED/ORGANIZED:*
Florida

REMITTANCE ADDRESS*

1760 S. Stemmons FWY, #300

Lewisville, TX 75067

BIDDER/PROPOSER'S AUTHORIZED REPRESENTATIVE'S TYPED FULL NAME*
Michael Brandao

IT IS HEREBY CERTIFIED AND AFFIRMED THAT THE BIDDER/PROPOSER CERTIFIES ACCEPTANCE OF THE TERMS, CONDITIONS, SPECIFICATIONS, ATTACHMENTS AND ANY ADDENDA. THE BIDDER/PROPOSER SHALL ACCEPT ANY AWARDS MADE AS A RESULT OF THIS SOLICITATION. BIDDER/PROPOSER FURTHER AGREES THAT PRICES QUOTED WILL REMAIN FIXED FOR THE PERIOD OF TIME STATED IN THE SOLICITATION.*
Confirmed

THE EXECUTION OF THIS FORM CONSTITUTES THE UNEQUIVOCAL OFFER OF BIDDER/PROPOSER TO BE BOUND BY THE TERMS OF ITS PROPOSAL. FAILURE TO SIGN THIS SOLICITATION WHERE INDICATED BY AN AUTHORIZED REPRESENTATIVE SHALL RENDER THE BID/PROPOSAL NON-RESPONSIVE. THE CITY MAY, HOWEVER, IN ITS SOLE DISCRETION, ACCEPT ANY BID/PROPOSAL THAT INCLUDES AN EXECUTED DOCUMENT WHICH UNEQUIVOCALLY BINDS THE BIDDER/PROPOSER TO THE TERMS OF ITS OFFER.*

Confirmed

PROPOSAL FORM*
Please download the below documents, complete, and upload.

- Proposal Form.docx

Proposal-Hollywood_Maintenance-JP-MB_Signed_and_Sealed.pdfBid_Guaranty_SRWWTP_Maintenance_-_Hollywood.pdf

10. SWORN STATEMENT PURSUANT TO SECTION 287.133 (3) (a) FLORIDA STATUTES ON PUBLIC ENTITY CRIMES

THIS FORM STATEMENT IS SUBMITTED TO THE CITY OF HOLLYWOOD BY:*
(Print individual's name and title) (Print name of entity submitting sworn statement)

Michael Brandao, Vice President, Cardinal Contractors, Inc.

SWORN STATEMENT CONTINUATION:*
Enter business address:

13794 NW 4th Street, Suite #200, Sunrise, FL 33325

SWORN STATEMENT CONTINUATION:*
Enter Federal Employer Identification Number (FEIN) is:

If the entity has no FEIN, include the Social Security Number of the individual signing this sworn statement.

80-0388786

SWORN STATEMENT CONTINUATION:*
I understand that "convicted" or "conviction" as defined in Paragraph 287.133(1)(b), Florida Statutes, means a finding of guilt or a conviction of a public entity crime, with or without an adjudication of guilt, in an federal or state trial court of record relating to

charges brought by indictment or information after July 1, 1989, as a result of a jury verdict, nonjury trial, or entry of a plea of guilty or nolo contendere.

N/A

SWORN STATEMENT CONTINUATION:*
I understand that "Affiliate," as defined in paragraph 287.133(1)(a), Florida Statutes, means:

1. A predecessor or successor of a person convicted of a public entity crime, or

2. An entity under the control of any natural person who is active in the management of the entity and who has been convicted of a public entity crime. The term "affiliate" includes those officers, directors, executives, partners, shareholders, employees, members, and agents who are active in the management of an affiliate. The ownership by one person of shares constituting a controlling interest in another person, or a pooling of equipment or income among persons when not for fair market value under an arm's length agreement, shall be a prima facie case that one person controls another person. A person who knowingly enters into a joint venture with a person who has been convicted of a public entity crime in Florida during the preceding 36 months shall be considered an affiliate.

Confirmed

SWORN STATEMENT CONTINUATION:*

I understand that “person,” as defined in Paragraph 287.133(1)(e), Florida Statues, means any natural person or any entity organized under the laws of any state or of the United States with the legal power to enter into a binding contract and which bids or applies to bid on contracts let by a public entity, or which otherwise transacts or applies to transact business with a public entity.

The term “person” includes those officers, executives, partners, shareholders, employees, members, and agents who are active in management of an entity

Confirmed

SWORN STATEMENT CONTINUATION:*
Based on information and belief, the statement which I have marked below is true in relation to the entity submitting this sworn statement. (Please indicate which statement applies.)

Division of Administrative Hearings, determined that it was not in the public interest to place the entity submitting this sworn statement on the convicted vendor list. (attach a copy of the Final Order).

Neither the entity submitting sworn statement, nor any of its officers, director, executives, partners, shareholders, employees, members, or agents who are active in the management of the entity, nor any affiliate of the entity has been charged with and convicted of a public entity crime subsequent to July 1, 1989.

SWORN STATEMENT CONFIRMATION*
I UNDERSTAND THAT THE SUBMISSION OF THIS FORM TO THE CONTRACTING OFFICER

FOR THE PUBLIC ENTITY IDENTIFIED IN PARAGRAPH 1 (ONE) ABOVE IS FOR THAT PUBLIC

ENTITY ONLY AND THAT THIS FORM IS VALID THROUGH DECEMBER 31 OF THE CALENDAR

YEAR IN WHICH IT IS FILED. I ALSO UNDERSTAND THAT I AM REQUIRED TO INFORM THAT

PUBLIC ENTITY PRIOR TO ENTERING INTO A CONTRACT IN EXCESS OF THE THRESHOLD

AMOUNT PROVIDED IN SECTION 287.017 FLORIDA STATUTES FOR A CATEGORY TWO OF

ANY CHANGE IN THE INFORMATION CONTAINED IN THIS FORM.

Confirmed

PRICE TABLES

BASE BID

Line Item	Description	Quantity	Unit of Measure	Unit Cost	Total
1	Mobilization (shall not exceed 3% of the sum of Bid Items No. 2 and No. 3).	1	Lump Sum	$93,000.00	$93,000.00
2	All work associated with the Demolition Phase including but not limited to, all general, civil, mechanical, electrical, structural, instrumentation, controls work elements, as detailed in the Contract Documents.	1	Lump Sum	$20,000.00	$20,000.00
3	All work required for the complete furnishing, delivery and installation of odor control facilities and instrument air handling system as required in the Contract Documents. This item includes, but is not limited to, all general, civil, mechanical, structural, architectural, electrical, instrumentation and control, equipment testing, startup services and construction sequencing required for a complete and operable system.	1	Lump Sum	$2,840,000.00	$2,840,000.00
4	Allowance for Inspections and Testing, for the price of:	1	Allowance	$15,000.00	$15,000.00
5	Allowance for Permits, Licenses and Fees for Government Agencies, for the price of:	1	Allowance	$60,000.00	$60,000.00
6	Allowance for Undefined Conditions, for the price of:	1	Allowance	$10,000.00	$10,000.00

Line Item	Description	Quantity	Unit of Measure	Unit Cost	Total
7	Consideration for Indemnification	1	Lump Sum	$10.00	$10.00
8	Demobilization (shall not exceed 3% of the sum of Bid Items No. 2 and No. 3).	1	Lump Sum	$93,000.00	$93,000.00
TOTAL					$3,131,010.00

VENDOR REFERENCE FORM

City of Hollywood Solicitation #: IFB-051-23-JJ
Reference for: Cardinal Contractors, Inc.

Organization/Firm Name providing reference: Lee County, FL
Organization/Firm Contact Name: Lyssa Lott
Title: Project Manager
Email: llott@leegov.com
Phone: 239-533-5672
Name of Referenced Project: Fiesta Village WRF Sludge & NaOCL Sys.
Contract No:
Date Services were provided: 07/2019-11/2022
Project Amount: $6.4M

Referenced Vendor's role in Project: ☒ **Prime Vendor** ☐ **Subcontractor/ Subconsultant**

Would you use the Vendor again? ☒ **Yes** ☐ **No. Please specify in additional comments**

Description of services provided by Vendor (provide additional sheet if necessary):
New high solids centrifuge with new platform, cake conveyance, piping, pumps & valves, new sludge pumps, piping & valves, reclaimed water
pumps, piping & valves, electrical & instrumentation improvements, pre-engineered canopy, sodium hypo feed pumps/piping & valves

Please rate your experience with the Vendor	**Need Improvement**	**Satisfactory**	**Excellent**	**Not Applicable**
Vendor's Quality of Service				
a. Responsive	☐	☐	☒	☐
b. Accuracy	☐	☐	☒	☐
c. Deliverables	☐	☐	☒	☐
Vendor's Organization:				
a. Staff expertise	☐	☐	☒	☐
b. Professionalism	☐	☐	☒	☐
c. Staff turnover	☐	☐	☒	☐
Timeliness/Cost Control of:				
a. Project	☐	☐	☒	☐
b. Deliverables	☐	☐	☒	☐

Additional Comments (provide additional sheet if necessary):

******THIS SECTION FOR CITY USE ONLY******						
Verified via:	**Email:**	☐	**Verbal:**	☐	**Mail:**	☐
Verified by:	**Name:**				**Title:**	
	Department:				**Date:**	

VENDOR REFERENCE FORM

City of Hollywood Solicitation #: IFB-051-23-JJ
Reference for: Cardinal Contractors, Inc.

Organization/Firm Name providing reference: City of Sunrise
Organization/Firm Contact Name: Tim Welch
Title: Project Manager
Email: twelch@sunrisefl.gov
Phone: 954-888-6055
Name of Referenced Project: Sawgrass WWTP Reuse Facility-Ph1
Contract No:
Date Services were provided: 11/2015-8/2016
Project Amount: $15M

Referenced Vendor's role in Project: ☒ **Prime Vendor** ☐ **Subcontractor/ Subconsultant**

Would you use the Vendor again? ☒ **Yes** ☐ **No. Please specify in additional comments**

Description of services provided by Vendor (provide additional sheet if necessary):
Construction of 9 MGD WWTP expansion

Please rate your experience with the Vendor	**Need Improvement**	**Satisfactory**	**Excellent**	**Not Applicable**
Vendor's Quality of Service				
a. Responsive	☐	☐	☒	☐
b. Accuracy	☐	☐	☒	☐
c. Deliverables	☐	☐	☒	☐
Vendor's Organization:				
a. Staff expertise	☐	☐	☒	☐
b. Professionalism	☐	☐	☒	☐
c. Staff turnover	☐	☐	☒	☐
Timeliness/Cost Control of:				
a. Project	☐	☐	☒	☐
b. Deliverables	☐	☐	☒	☐

Additional Comments (provide additional sheet if necessary):

******THIS SECTION FOR CITY USE ONLY******						
Verified via:	**Email:**	☐	**Verbal:**	☐	**Mail:**	☐
Verified by:	**Name:**				**Title:**	
	Department:				**Date:**	

VENDOR REFERENCE FORM

City of Hollywood Solicitation #: IFB-051-23-JJ
Reference for: Cardinal Contractors, Inc.

Organization/Firm Name providing reference: City of Sunrise
Organization/Firm Contact Name: Tim Welch
Title: Project Manager
Email: twelch@sunrisefl.gov
Phone: 954-888-6055
Name of Referenced Project: Springtree WWTP-Headworks Impr.
Contract No:
Date Services were provided: 10/2019-10/2022
Project Amount: $9.3M

Referenced Vendor's role in Project: ☒ **Prime Vendor** ☐ **Subcontractor/ Subconsultant**

Would you use the Vendor again? ☒ **Yes** ☐ **No. Please specify in additional comments**

Description of services provided by Vendor (provide additional sheet if necessary):
Rehab the existing headworks structure at the Springtree WWTP

Please rate your experience with the Vendor	**Need Improvement**	**Satisfactory**	**Excellent**	**Not Applicable**
Vendor's Quality of Service				
a. Responsive	☐	☐	☒	☐
b. Accuracy	☐	☐	☒	☐
c. Deliverables	☐	☐	☒	☐
Vendor's Organization:				
a. Staff expertise	☐	☐	☒	☐
b. Professionalism	☐	☐	☒	☐
c. Staff turnover	☐	☐	☒	☐
Timeliness/Cost Control of:				
a. Project	☐	☐	☒	☐
b. Deliverables	☐	☐	☒	☐

Additional Comments (provide additional sheet if necessary):

******THIS SECTION FOR CITY USE ONLY******						
Verified via:	**Email:**	☐	**Verbal:**	☐	**Mail:**	☐
Verified by:	**Name:**				**Title:**	
	Department:				**Date:**	

VENDOR REFERENCE FORM

City of Hollywood Solicitation #: IFB-051-23-JJ
Reference for: Cardinal Contractors, Inc.

Organization/Firm Name providing reference: Desoto County BOCC
Organization/Firm Contact Name: Cindy Talamantez
Title: Project Manager
Email: c.talamantez@desotobocc.com
Phone: 863-993-4816
Name of Referenced Project: Regional WWTP Rehab & Repair
Contract No:
Date Services were provided: 2/2021-current, project is substantially complete
Project Amount: $4.2M

Referenced Vendor's role in Project: ☒ **Prime Vendor** ☐ **Subcontractor/ Subconsultant**

Would you use the Vendor again? ☒ **Yes** ☐ **No. Please specify in additional comments**

Description of services provided by Vendor (provide additional sheet if necessary):
New headworks and screening devices, odor control system rehab, rehab of steel tanks, new coatings, new chemical dosing system

Please rate your experience with the Vendor	**Need Improvement**	**Satisfactory**	**Excellent**	**Not Applicable**
Vendor's Quality of Service				
a. Responsive	☐	☐	☒	☐
b. Accuracy	☐	☐	☒	☐
c. Deliverables	☐	☐	☒	☐
Vendor's Organization:				
a. Staff expertise	☐	☐	☒	☐
b. Professionalism	☐	☐	☒	☐
c. Staff turnover	☐	☐	☒	☐
Timeliness/Cost Control of:				
a. Project	☐	☐	☒	☐
b. Deliverables	☐	☐	☒	☐

Additional Comments (provide additional sheet if necessary):

******THIS SECTION FOR CITY USE ONLY******						
Verified via:	**Email:**	☐	**Verbal:**	☐	**Mail:**	☐
Verified by:	**Name:**				**Title:**	
	Department:				**Date:**	

CERTIFICATE OF LIABILITY INSURANCE

DATE (MM/DD/YYYY): 06/09/2023

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
McGriff Insurance Services, LLC
10100 Katy Freeway, #400
Houston, TX 77043

CONTACT NAME: Rachel Manis-Hyatt
PHONE (A/C, No, Ext): 713-877-8975 **FAX (A/C, No):** 713-877-8974
E-MAIL ADDRESS: rmanis-hyatt@mcgriff.com

INSURER(S) AFFORDING COVERAGE	NAIC #
INSURER A : Hartford Accident and Indemnity Company	22357
INSURER B : Twin City Fire Insurance Company	29459
INSURER C : Hartford Fire Insurance Company	19682
INSURER D : Axis Surplus Insurance Company	26620
INSURER E : Gotham Insurance Company	25569
INSURER F : Oxford Insurance Company TN LLC	17142

INSURED
Cardinal Contractors, Inc.
13794 NW 4th Street
Suite 200
Sunrise, FL 33325

COVERAGES **CERTIFICATE NUMBER:** JPYVS2TT **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)	LIMITS	
C	X **COMMERCIAL GENERAL LIABILITY** [ ] CLAIMS-MADE [X] OCCUR GEN'L AGGREGATE LIMIT APPLIES PER: [ ] POLICY [X] PRO-JECT [ ] LOC [ ] OTHER:			61CSEQU3414	02/28/2023	02/28/2024	EACH OCCURRENCE DAMAGE TO RENTED PREMISES (Ea occurrence) MED EXP (Any one person) PERSONAL & ADV INJURY GENERAL AGGREGATE PRODUCTS - COMP/OP AGG	$ 2,000,000 $ 2,000,000 $ 10,000 $ 2,000,000 $ 4,000,000 $ 4,000,000
C	**AUTOMOBILE LIABILITY** X ANY AUTO [ ] OWNED AUTOS ONLY [ ] SCHEDULED AUTOS [ ] HIRED AUTOS ONLY [ ] NON-OWNED AUTOS ONLY			61CSEQU3415	02/28/2023	02/28/2024	COMBINED SINGLE LIMIT (Ea accident) BODILY INJURY (Per person) BODILY INJURY (Per accident) PROPERTY DAMAGE (Per accident) Physical Damage Ded.	$ 2,000,000 $ $ $ $ 250,000
D F	X **UMBRELLA LIAB** X OCCUR **EXCESS LIAB** [ ] CLAIMS-MADE DED [X] RETENTION $			P-001-000806562-02 1001-23-1	02/28/2023	02/28/2024	EACH OCCURRENCE AGGREGATE	$ 10,000,000 $ 10,000,000
A B	**WORKERS COMPENSATION AND EMPLOYERS' LIABILITY** Y / N ANY PROPRIETOR/PARTNER/EXECUTIVE OFFICER/MEMBER EXCLUDED? N **(Mandatory in NH)** If yes, describe under DESCRIPTION OF OPERATIONS below	N / A		61WNQU3411 61WBRQU3412 61XWEQU3413 $500,000 Ded/SIR applies to all	02/28/2023	02/28/2024	X PER STATUTE [ ] OTH-ER E.L. EACH ACCIDENT E.L. DISEASE - EA EMPLOYEE E.L. DISEASE - POLICY LIMIT	 $ 1,000,000 $ 1,000,000 $ 1,000,000
E	Automobile Excess Liability			EX202300003084	02/28/2023	02/28/2024	Each Loss Aggregate	$ 3,000,000 $ 3,000,000

DESCRIPTION OF OPERATIONS / LOCATIONS / VEHICLES (ACORD 101, Additional Remarks Schedule, may be attached if more space is required)
In the event of cancellation by the insurance companies the policies have been endorsed to provide (30) days Notice of Cancellation (except for non-payment) to the Certificate Holder shown below. The City of Hollywood is included as Additional Insured as respects the General Liability, Auto Liability and Umbrella Liability policies. A Waiver of Subrogation is provided in favor of The City of Hollywood as respects the General Liability, Auto Liability, Umbrella Liability and Workers' Compensation policies. General Liability, Auto Liability and Umbrella Liability policies are Primary and Non-Contributory. All as required by written contract and subject to policy terms, conditions and exclusions.

CERTIFICATE HOLDER

The City of Hollywood
2600 Hollywood Blvd.
Hollywood, FL 33020

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 R Michael Breedlove, JR

AGENCY CUSTOMER ID: _____

LOC #: _____

ADDITIONAL REMARKS SCHEDULE

PRODUCER McGriff Insurance Services, LLC	**INSURED** Cardinal Contractors, Inc.
POLICY NUMBER	
CARRIER / **NAIC CODE**	**ISSUE DATE:** 06/09/2023

ADDITIONAL REMARKS

THIS ADDITIONAL REMARKS FORM IS A SCHEDULE TO ACORD FORM,

FORM NUMBER: _____ **FORM TITLE:** _____

Contractor's Pollution Liability

Term: February 28, 2022 - February 28, 2024
Policy #: CPO1238582
Carrier: AIG Specialty Insurance Co

Limits
Each Claim: $10,000,000
Aggregate: $10,000,000

Coverage Territory includes Canada

CERTIFICATE NUMBER: JPYVS2TT

PROPOSAL

TO THE MAYOR AND COMMISSIONERS
CITY OF HOLLYWOOD, FLORIDA

SUBMITTED __June 19, 2023_____

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 Program, 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 365 calendar days with final completion within 30 days, and 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 Ordinance, Exhibit A.

The BIDDER acknowledges receipt of the any and all addenda.

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

_____5% of the bid amount_____ 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)

_____(SEAL)

(Signature of Individual)

****

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:

Cardinal Contractors, Inc.
(Correct Name of Corporation)

By: _____
(SEAL) Michael Brandao

Vice President
(Official Title)

13794 NW 4th Street, Suite 200, Sunrise, FL 33325
(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

Cardinal Contractors, Inc.
(Name of Corporation)

RESOLVED that Michael Brandao
(Person Authorized to Sign)

Vice President of Cardinal Contractors, Inc.
(Title) (Name of Corporation)

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

SRWWTP Maintenance Work
ESSD Project #9626
Bid No. IFB-087-23-JJ

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

Cardinal Contractors, Inc at a meeting of its Board of
(Name of Corporation)

Directors held on March 1, 2022

By: _____
John M. Perisich

Title: Corporate Secretary

(SEAL)

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

- END OF SECTION -

Form 13

Bid Guaranty Form

(Construction)

STATE OF FLORIDA

KNOW ALL MEN BY THESE PRESENTS:
That we Cardinal Contractors, Inc., as Principal, and Federal Insurance Company AND The Continental Insurance Company, as Surety, are held and firmly bound unto the City of Hollywood in the sum of Five Percent of the Total Solicitation Price Dollars ($ 5% TSP) lawful money of the United States, amounting to 5% of the total SOLICITATION 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 SOLICITATION, dated June 14, 2023 20 for

2023 SRWWTP MAINTENANCE WORK
SOLICITATION

NOW, THEREFORE, if the principal shall not withdraw said SOLICITATION 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 SOLICITATION 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.

In the event of the withdrawal of said SOLICITATION 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 SOLICITATION 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 SOLICITATION.

IN WITNESS WHEREOF, the above bound parties have executed this statement under their several seals this 7th day of June, 2023, 20X 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:

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

Cardinal Contractors, Inc.
Name of Corporation

13794 NW 4th Street, Suite 200, Sunrise, FL 33325
Business Address

By: _____
(Affix Corporate Seal)

MICHAEL BRANDAO
Printed Name

VICE PRESIDENT
Official Title

CERTIFICATE AS TO CORPORATE PRINCIPAL

I, John M. Perisich, certify that I am the secretary of the Corporation named as Principal in the attached bond; that Michael Brandao 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

Approved SOLICITATION Bond

TO BE EXECUTED BY CORPORATE SURETY:

Attest:

~~Secretary~~ Maria D. Zuniga
Attorney-in-Fact
Florida Non-Resident
License No. W100173

Federal Insurance Company AND
The Continental Insurance Company
Corporate Surety
FIC: 202B Hall's Mill Road, Whitehouse Station, NJ 08889
Business Address
CIC: 151 N. Franklin St., Chicago, IL 60606

BY: _____
(Affix Corporate Seal)

Vickie Lacy, Florida Non-Resident License No. W104273
Attorney-in-Fact
Benjamin R. Campbell Jr., Florida Resident License No. A038916

3522 Thomasville Rd FL 3
Business Address
Tallahassee, FL 32309-3479

Name of Local Agency

STATE OF ~~FLORIDA~~ TEXAS

Before me, a Notary Public, duly commissioned, qualified and acting, personally appeared, Vickie Lacy to me well known, who being by me first duly sworn upon oath says that he is the attorney-in-fact for the Federal Insurance Company AND The Continental Insurance Company and that the has been authorized by Federal Insurance Company AND The Continental 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 7th day of June, 20 23

Notary Public, State of ~~Florida~~ Texas
Diana Castillo
Notary ID 132737564

My Commission Expires: October 20, 2024

- END OF SECTION-

DIANA ELIZABETH CASTILLO
Notary Public, State of Texas
Comm. Expires 10-20-2024
Notary ID 132737564

CHUBB

Power of Attorney

Federal Insurance Company | Vigilant Insurance Company | Pacific Indemnity Company
Westchester Fire Insurance Company | ACE American Insurance Company

Know All by These Presents, that **FEDERAL INSURANCE COMPANY,** an Indiana corporation, **VIGILANT INSURANCE COMPANY,** a New York corporation, **PACIFIC INDEMNITY COMPANY,** a Wisconsin corporation, **WESTCHESTER FIRE INSURANCE COMPANY** and **ACE AMERICAN INSURANCE COMPANY** corporations of the Commonwealth of Pennsylvania, do each hereby constitute and appoint Joseph R. Aulbert, Marc W. Boots, Richard Covington, Ashley Koletar, Vickie Lacy, Heather Noles, Ryan Varela and Maria D. Zuniga of Houston, Texas; Susan Golla of San Antonio, Texas ----------

each as their true and lawful Attorney-in-Fact to execute under such designation in their names and to affix their corporate seals to and deliver for and on their behalf as surety thereon or otherwise, bonds and undertakings and other writings obligatory in the nature thereof (other than bail bonds) given or executed in the course of business, and any instruments amending or altering the same, and consents to the modification or alteration of any instrument referred to in said bonds or obligations.

In Witness Whereof, said **FEDERAL INSURANCE COMPANY, VIGILANT INSURANCE COMPANY, PACIFIC INDEMNITY COMPANY, WESTCHESTER FIRE INSURANCE COMPANY** and **ACE AMERICAN INSURANCE COMPANY** have each executed and attested these presents and affixed their corporate seals on this **14th** day of **October, 2022.**

Dawn M. Chloros, Assistant Secretary

Stephen M Haney, Vice President

STATE OF NEW JERSEY
County of Hunterdon ss.

On this **14th** day of **October, 2022** before me, a Notary Public of New Jersey, personally came Dawn M. Chloros and Stephen M. Haney, to me known to be Assistant Secretary and Vice President, respectively, of FEDERAL INSURANCE COMPANY, VIGILANT INSURANCE COMPANY, PACIFIC INDEMNITY COMPANY, WESTCHESTER FIRE INSURANCE COMPANY and ACE AMERICAN INSURANCE COMPANY, the companies which executed the foregoing Power of Attorney, and the said Dawn M. Chloros and Stephen M. Haney, being by me duly sworn, severally and each for herself and himself did depose and say that they are Assistant Secretary and Vice President, respectively, of FEDERAL INSURANCE COMPANY, VIGILANT INSURANCE COMPANY, PACIFIC INDEMNITY COMPANY, WESTCHESTER FIRE INSURANCE COMPANY and ACE AMERICAN INSURANCE COMPANY and know the corporate seals thereof, that the seals affixed to the foregoing Power of Attorney are such corporate seals and were thereto affixed by authority of said Companies; and that their signatures as such officers were duly affixed and subscribed by like authority.

Notarial Seal

KATHERINE J. ADELAAR
NOTARY PUBLIC OF NEW JERSEY
No. 2316685
Commission Expires July 16, 2024

Notary Public

CERTIFICATION

Resolutions adopted by the Boards of Directors of FEDERAL INSURANCE COMPANY, VIGILANT INSURANCE COMPANY, and PACIFIC INDEMNITY COMPANY on August 30, 2016; WESTCHESTER FIRE INSURANCE COMPANY on December 11, 2006; and ACE AMERICAN INSURANCE COMPANY on March 20, 2009:

"RESOLVED, that the following authorizations relate to the execution, for and on behalf of the Company, of bonds, undertakings, recognizances, contracts and other written commitments of the Company entered into in the ordinary course of business (each a "Written Commitment"):

(1) Each of the Chairman, the President and the Vice Presidents of the Company is hereby authorized to execute any Written Commitment for and on behalf of the Company, under the seal of the Company or otherwise.

(2) Each duly appointed attorney-in-fact of the Company is hereby authorized to execute any Written Commitment for and on behalf of the Company, under the seal of the Company or otherwise, to the extent that such action is authorized by the grant of powers provided for in such person's written appointment as such attorney-in-fact.

(3) Each of the Chairman, the President and the Vice Presidents of the Company is hereby authorized, for and on behalf of the Company, to appoint in writing any person the attorney-in-fact of the Company with full power and authority to execute, for and on behalf of the Company, under the seal of the Company or otherwise, such Written Commitments of the Company as may be specified in such written appointment, which specification may be by general type or class of Written Commitments or by specification of one or more particular Written Commitments.

(4) Each of the Chairman, the President and the Vice Presidents of the Company is hereby authorized, for and on behalf of the Company, to delegate in writing to any other officer of the Company the authority to execute, for and on behalf of the Company, under the Company's seal or otherwise, such Written Commitments of the Company as are specified in such written delegation, which specification may be by general type or class of Written Commitments or by specification of one or more particular Written Commitments.

(5) The signature of any officer or other person executing any Written Commitment or appointment or delegation pursuant to this Resolution, and the seal of the Company, may be affixed by facsimile on such Written Commitment or written appointment or delegation.

FURTHER RESOLVED, that the foregoing Resolution shall not be deemed to be an exclusive statement of the powers and authority of officers, employees and other persons to act for and on behalf of the Company, and such Resolution shall not limit or otherwise affect the exercise of any such power or authority otherwise validly granted or vested."

I, Dawn M. Chloros, Assistant Secretary of FEDERAL INSURANCE COMPANY, VIGILANT INSURANCE COMPANY, PACIFIC INDEMNITY COMPANY, WESTCHESTER FIRE INSURANCE COMPANY and ACE AMERICAN INSURANCE COMPANY (the "Companies") do hereby certify that

(i) the foregoing Resolutions adopted by the Board of Directors of the Companies are true, correct and in full force and effect,
(ii) the foregoing Power of Attorney is true, correct and in full force and effect.

Given under my hand and seals of said Companies at Whitehouse Station, NJ, this 7th day of June, 2023.

Dawn M. Chloros, Assistant Secretary

IN THE EVENT YOU WISH TO VERIFY THE AUTHENTICITY OF THIS BOND OR NOTIFY US OF ANY OTHER MATTER, PLEASE CONTACT US AT:
Telephone (908) 903-3493 Fax (908) 903-3656 e-mail: surety@chubb.com

POWER OF ATTORNEY APPOINTING INDIVIDUAL ATTORNEY-IN-FACT

Know All Men By These Presents, That The Continental Insurance Company, a Pennsylvania insurance company, is a duly organized and existing insurance company having its principal office in the City of Chicago, and State of Illinois, and that it does by virtue of the signature and seal herein affixed hereby make, constitute and appoint

Marc W Boots, Vickie Lacy, Richard Covington, Maria D Zuniga, Heather Noles, Joseph R Aulbert, Ashley Koletar, Ryan Varela, Individually

of Houston, TX, its true and lawful Attorney(s)-in-Fact with full power and authority hereby conferred to sign, seal and execute for and on its behalf bonds, undertakings and other obligatory instruments of similar nature

- In Unlimited Amounts -

and to bind them thereby as fully and to the same extent as if such instruments were signed by a duly authorized officer of the insurance company and all the acts of said Attorney, pursuant to the authority hereby given is hereby ratified and confirmed.

This Power of Attorney is made and executed pursuant to and by authority of the By-Law and Resolutions, printed on the reverse hereof, duly adopted, as indicated, by the Board of Directors of the insurance company.

In Witness Whereof, The Continental Insurance Company has caused these presents to be signed by its Vice President and its corporate seal to be hereto affixed on this 1st day of November, 2022.

The Continental Insurance Company

Paul T. Bruflat — Vice President

State of South Dakota, County of Minnehaha, ss:

On this 1st day of November, 2022, before me personally came Paul T. Bruflat to me known, who, being by me duly sworn, did depose and say: that he resides in the City of Sioux Falls, State of South Dakota; that he is a Vice President of The Continental Insurance Company, a Pennsylvania insurance company, described in and which executed the above instrument; that he knows the seal of said insurance company; that the seal affixed to the said instrument is such corporate seal; that it was so affixed pursuant to authority given by the Board of Directors of said insurance company and that he signed his name thereto pursuant to like authority, and acknowledges same to be the act and deed of said insurance company.

M. BENT
NOTARY PUBLIC
SOUTH DAKOTA

My Commission Expires March 2, 2026

M. Bent — Notary Public

CERTIFICATE

I, D. Johnson, Assistant Secretary of The Continental Insurance Company, a Pennsylvania insurance company, do hereby certify that the Power of Attorney herein above set forth is still in force, and further certify that the By-Law and Resolution of the Board of Directors of the insurance company printed on the reverse hereof is still in force. In testimony whereof I have hereunto subscribed my name and affixed the seal of the said insurance company this 7th day of June, 2023.

The Continental Insurance Company

D. Johnson — Assistant Secretary

Form F6850-4/2012

Go to www.cnasurety.com > Owner / Obligee Services > Validate Bond Coverage, if you want to verify bond authenticity.

Authorizing By-Laws and Resolutions

ADOPTED BY THE BOARD OF DIRECTORS OF THE CONTINENTAL INSURANCE COMPANY:

This Power of Attorney is made and executed pursuant to and by authority of the following By-Law duly adopted by the Board of Directors of the Company at a meeting held on May 10, 1995.

> "RESOLVED: That any Group Vice President may authorize an officer to sign specific documents, agreements and instruments on behalf of the Company provided that the name of such authorized officer and a description of the documents, agreements or instruments that such officer may sign will be provided in writing by the Group Vice President to the Secretary of the Company prior to such execution becoming effective.

This Power of Attorney is signed by Paul T. Bruflat, Vice President, who has been authorized pursuant to the above resolution to execution power of attorneys on behalf of The Continental Insurance Company.

This Power of Attorney is signed and sealed by facsimile under and by the authority of the following Resolution adopted by the Board of Directors of the Company by unanimous written consent dated the 25th day of April, 2012.

> "Whereas, the bylaws of the Company or specific resolution of the Board of Directors has authorized various officers (the "Authorized Officers") to execute various policies, bonds, undertakings and other obligatory instruments of like nature; and
>
> Whereas, from time to time, the signature of the Authorized Officers, in addition to being provided in original, hard copy format, may be provided via facsimile or otherwise in an electronic format (collectively, "Electronic Signatures"), Now therefore be it resolved: that the Electronic Signature of any Authorized Officer shall be valid and binding on the Company."

Ron DeSantis, Governor

Melanie S. Griffin, 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

BRANDAO, MICHAEL LUIS

CARDINAL CONTRACTORS, INC.
13794 NW 4TH STREET SUITE 200
SUNRISE FL 33325

LICENSE NUMBER: CGC1529337

EXPIRATION DATE: AUGUST 31, 2024

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.

FORM 15

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: Cardinal Contractors, Inc.
13794 NW 4th Street, Suite 200 Sunrise, FL 33325

2. Contractor's Telephone Number: 941-377-8555
and e-mail address: john.taylor@prim.com

3. Contractor's License (attach copy): attached
Primary Classification: CGC1529337
Broward County License Number (attach copy): CGC1529337

4. Number of years as a Contractor in construction work of the type involved in this Contract: Incorporated 11/19/2003-approaximately 20 years

5. List the names and titles of all officers of Contractor's firm:
President-Robert Bridges, Vice President-Michael Brandao, Secretary-John Perisich
CFO-Blanche Arceneaux, Director-Ken Dodgen, Director-Tom McCormick

6. Name of person who inspected site or proposed work for your firm:
Name: Vincent Capuozzi
Date of Inspection: The site visit after the prebid conference on May 24, 2023

7. What is the last project of this nature you have completed?
City of Sunrise-Springtree Headworks Improvements Project

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:

Tim Welch-City of Sunrise, twelch@sunrisefl.gov, 954-888-0655

Lyssa Lott-Lee County, llott@leegov.com, 239-533-5672

Feng "Jeff" Jiang-City of Hollywood, fjiang@hollywoodfl.org, 954-921-3930

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 coventures).

Name of Project	City	Total Contract Value	Contracted Date of Completion	% Completion to Date
see attached list				

(Continue list on inset sheet, if necessary)

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

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

none

13. List at least three (3) similar projects completed within the last ten (10) years by the bidder. For purposes of this requirement, ‘similar’ projects shall be considered to include experience with dewatering facilities, grit removal facilities,

concrete repair in WWTP headworks and gate replacement. Include owner's contact information (client's name, address, telephone number and email address), project value, completion date, reference contact information and brief project description. The determination of whether a project is sufficiently similar shall be at the sole discretion of the City and the Engineer.

see attached vendor reference forms-note the originally submitted form for the Sawgrass project had an incorrect completion date of 08/2016, it should have been 06/2018 and has been corrected

(Add sheets as requested.)

14. Name the Project Manager proposed for this project. Attach a copy of the project manager's resume.

Juan Gonzalez

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 (NOT USED/See Form 14)

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 lump sum base 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.

	Work to be Performed	**Subcontractor's Name / Address**
1.	Painting & Coatings	Titans Protective Coatings, LLC
		150 Evernia, Street, Suite B, Jupiter, FL 33458
2.	Metal Canopy	J.T. Welding, Inc.
		5816 Funston Street, Hollywood, FL 33023
3.	Electrical	Loveland Electric, Inc.
		1344 South Killian Drive, Lake Park, FL 33403
4.		
5.		
6.		
7.		
8.		
9.		
10.		

NOTE: Attach additional sheets if required.

END OF SECTION

Primoris Services Corporation

Cardinal Contractors, Inc

For Month Ending: 7/31/2023

Group	CO-Dept	Job No.	Customer
0	10-4000	31902	CITY OF PEMBROKE PINES
0	10-4000	85000	MISCELLANEOUS CUSTOMER
0	10-4000	85002	BROWARD CBO COMMISSIONERS
0	10-4000	85012	BROWARD CBO COMMISSIONERS
0	10-4000	85015	GASPARILLA ISLAND WATER ASSOCIATION INC
0	10-4000	85021	CITY OF RIVIERA BEACH
0	10-4000	85022	DESOTO COUNTY
0	10-4000	85023	CH2M HILL, INC.
0	10-4000	85025	SARASOTA COUNTY
0	10-4000	85026	PALM BEACH COUNTY
0	10-4000	85027	PALM BEACH COUNTY
0	10-4000	85028	PALM BEACH COUNTY
0	10-4000	85029	ECKLER ENGINEERING, INC.
0	10-4000	85030	CITY OF HOLLYWOOD
0	10-4000	85031	PALM BEACH COUNTY
0	10-4000	85032	CH2M HILL, INC.
0	10-4000	85033	BOCA RATON
0	10-4000	85034	CITY OF HALLANDALE BEACH
0	10-4000	85999	MISCELLANEOUS CUSTOMER
Total	**10-4000**		
0	10-7000	71502	CITY OF GALVESTON, TEXAS
0	10-7000	85017	BALFOUR BEATTY LLC
Total	**10-7000**		

Report Total

Description	EstimatedCompletionDate	EstimatedPhysical % Complete
PEMBROKE PINES WWTP DB-PH 1	06/30/2023	99.00%
MISC PROJECTS / EMERGENCY WORK		0.00%
MASTER PUMP STATION CONTROLS UPGRADE	10/30/2023	94.00%
MASTER PUMP STATION 454	08/30/2023	98.00%
WASTEWATER TREATMENT PLANT PHASE 2 EXPANSION	07/31/2023	93.00%
RIVIERA BEACH WTP CHEMICAL FEED	08/30/2023	100.00%
REGIONAL WWTP REHAB AND REPAIR	12/31/2023	89.00%
DL TIPPIN HSPS & MISC IMPROVEMENTS	12/30/2023	87.00%
CARLTON WTP REHAB PHASE 2	09/11/2023	95.00%
PBC - WTP3 & SROC ELECTRICAL IMPROVEMENTS	06/30/2024	87.00%
SRWRF SINGLE-ZONE MONITOR WELL	01/21/2024	7.00%
SRWRF PRE-TREATMENT AND ANALYZER IMPROVEMENTS	03/27/2024	58.00%
CORAL SPRINGS WTP NAOCL SYSTEM UPGRADE	08/30/2023	95.00%
HOLLYWOOD DIW 3 & 4 PUMP STATION	02/09/2025	30.00%
REPUMP STATION NO. 8310 UPGADES AND IMPROVEMENTS	06/30/2024	16.00%
RO WTP PHASE III & WELLFIELD EXPANSION	01/31/2023	100.00%
BOCA RATON WTP 4-LOG TREATMENT UPGRADE	11/07/2024	0.00%
WATER TREATMENT PLANT REVERSE OSMOSIS SKID ADDITION	08/22/2024	0.00%
PRIOR YEAR WARRANTY WORK - 2021	12/31/2021	0.00%
CITY OF GALVESTON 59TH ST PUMP STATION	09/30/2023	100.00%
NORTHEAST WPP - NORTH PLANT GRT 501,503,504	05/20/2022	100.00%

Original Contract Value	Approved Change Orders	Revised Contract Value	Projected Contract Value
5,391,255.10	415,655.92	5,806,911.02	5,805,054.48
0.00	229,529.51	229,529.51	477,846.44
3,918,250.00	152,746.10	4,070,996.10	4,014,991.11
4,765,650.00	18,896.00	4,784,546.00	4,680,071.92
7,347,550.00	350,000.00	7,697,550.00	8,996,398.62
6,630,354.00	183,400.97	6,813,754.97	6,611,140.98
1,683,745.00	2,560,997.00	4,244,742.00	4,244,742.00
11,949,886.00	985,357.01	12,935,243.01	13,106,129.75
4,670,055.00	0.00	4,670,055.00	4,483,476.35
3,464,500.00	95,116.47	3,559,616.47	3,509,616.47
4,505,812.00	0.00	4,505,812.00	4,325,812.00
4,724,105.00	0.00	4,724,105.00	4,658,696.12
1,093,872.00	0.00	1,093,872.00	1,086,338.41
112,299,970.00	0.00	112,299,970.00	108,636,093.61
2,697,000.00	0.00	2,697,000.00	2,617,850.73
149,000.00	0.00	149,000.00	149,000.00
13,607,150.00	0.00	13,607,150.00	13,307,150.00
4,284,618.00	0.00	4,284,618.00	4,174,618.00
0.00	0.00	0.00	0.00
193,182,772.10	**4,398,615.66**	**198,174,471.08**	**194,885,026.99**
15,887,000.00	6,570,348.69	22,457,348.69	22,457,348.69
6,300,000.00	-1,841,572.00	4,458,428.00	4,458,428.00
22,187,000.00	**4,728,776.69**	**26,915,776.69**	**26,915,776.69**
215,369,772.10	**9,127,392.35**	**225,090,247.77**	**221,800,803.68**

BROWARD COUNTY LOCAL BUSINESS TAX RECEIPT

115 S. Andrews Ave., Rm. A-100, Ft. Lauderdale, FL 33301-1895 – 954-831-4000

VALID OCTOBER 1, 2022 THROUGH SEPTEMBER 30, 2023

DBA:
Business Name: CARDINAL CONTRACTORS, LLC

Receipt #: 180-310509
Business Type: GENERAL CONTRACTOR (CERT GENERAL CONTRACTOR)

Owner Name: MICHAEL BRANDAO
Business Location: 13794 NW 4 ST STE 200 SUNRISE
Business Phone: 941-377-8555

Business Opened: 11/20/2020
State/County/Cert/Reg: CGC1529337
Exemption Code:

Rooms	Seats	Employees	Machines	Professionals
		67		

For Vending Business Only

Number of Machines: **Vending Type:**

Tax Amount	Transfer Fee	NSF Fee	Penalty	Prior Years	Collection Cost	Total Paid
150.00	0.00	0.00	0.00	0.00	0.00	150.00

THIS RECEIPT MUST BE POSTED CONSPICUOUSLY IN YOUR PLACE OF BUSINESS

THIS BECOMES A TAX RECEIPT

WHEN VALIDATED

This tax is levied for the privilege of doing business within Broward County and is non-regulatory in nature. You must meet all County and/or Municipality planning and zoning requirements. This Business Tax Receipt must be transferred when the business is sold, business name has changed or you have moved the business location. This receipt does not indicate that the business is legal or that it is in compliance with State or local laws and regulations.

Mailing Address:

CARDINAL CONTRACTORS, LLC
13794 NW 4 ST STE 200
SUNRISE, FL 33325

Receipt #WWW-21-00237141
Paid 07/12/2022 150.00

2022 - 2023

BROWARD COUNTY LOCAL BUSINESS TAX RECEIPT

115 S. Andrews Ave., Rm. A-100, Ft. Lauderdale, FL 33301-1895 – 954-831-4000

VALID OCTOBER 1, 2022 THROUGH SEPTEMBER 30, 2023

DBA:
Business Name: CARDINAL CONTRACTORS, LLC

Receipt #: 180-310509
Business Type: GENERAL CONTRACTOR (CERT GENERAL CONTRACTOR)

Owner Name: MICHAEL BRANDAO
Business Location: 13794 NW 4 ST STE 200 SUNRISE
Business Phone: 941-377-8555

Business Opened: 11/20/2020
State/County/Cert/Reg: CGC1529337
Exemption Code:

Rooms	Seats	Employees	Machines	Professionals
		67		

Signature

For Vending Business Only

Number of Machines: **Vending Type:**

Tax Amount	Transfer Fee	NSF Fee	Penalty	Prior Years	Collection Cost	Total Paid
150.00	0.00	0.00	0.00	0.00	0.00	150.00

Receipt #WWW-21-00237141
Paid 07/12/2022 150.00

ATTACHMENT A
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

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:

Oxygenation Flow Distribution Box Odor Control System Replacement
Project Bid No. IFB-051-23-JJ

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 One Hundred Thirty-One Ten Dollars and Zero Cents ($3,131,010.00)**.

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 five percent (5%) 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. 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 my 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.	Introduction	15.	General Terms and Conditions
2.	Special Terms and Conditions	16.	Scope of Services
3.	Submittal Checklist Form	17.	Contract
4.	Acknowledgement and Signature Page	18.	Drug-Free Workplace Program
5.	Bid Form	19.	Solicitation, Giving, and Acceptance…
6.	Vendor Reference Form	20.	W-9 (Request for Taxpayer Identification)
7.	Hold Harmless and Indemnity Clause	21.	Performance Bond
8.	Proposal	22.	Payment Bond
9.	Non-Collusion Affidavit	23.	General Conditions, Public Utilities
10.	Sworn Statement…Public Entity Crimes	24.	Supplementary General Conditions
11	Information Required from Bidders	25.	Addenda
12.	Certifications Regarding Debarment…	26.	Specifications
13.	Trench Safety Form	27.	Drawings
14.	Bid Guaranty Form	28.	List of Subcontractors

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:

By
_____

DOUGLAS R. GONZALES
City Attorney

APPROVED AS TO FINANCE:

By
_____

David E. Keller
Financial Services 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 -

ATTACHMENT A
PERFORMANCE 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 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 **Oxygenation Flow Distribution Box Odor Control System Replacement, Project Bid No. IFB-051-23-JJ.**

A copy of said Contract, **No. IFB-051-23-JJ** 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 Introduction, Special Terms and Conditions, Scope of Services, General Terms & Conditions, Submittal Checklist Form, Instructions to Bidders, Proposal, Proposal Bid Form, Basis of Payment, Bid Guaranty Form , Trench Safety Form, Information Required from Bidders, Vendor Reference Forms, Hold Harmless and Indemnity Clause, Non-Collusion Affidavit, Sworn Statement…Public Entity Crimes, Certifications Regarding Debarment… , Drug-Free Workplace Program, Solicitation, Giving, and Acceptance…, 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)

_____ By: _____
(Seal)
(Address) (Signature of Individual)

_____
(Witness)

_____
Address

WHEN THE PRINCIPAL IS A PARTNERSHIP:

Signed, sealed and delivered in the presence of:

_____ _____
(Witness) (Name of Partnership)

_____ By: _____
(Seal)
(Address) (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.

_____ (SEAL)
Secretary

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: APPROVED AS TO FINANCE:

By _____ By _____
Douglas R. Gonzales David E. Keller
City Attorney Financial Services Director

- END OF SECTION -

ATTACHMENT A
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 **Oxygenation Flow Distribution Box Odor Control System Replacement, Project Bid No. IFB-051-23-JJ.**

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:

By _____
Douglas R. Gonzales
City Attorney

APPROVED AS TO FINANCE:

By _____
David E. Keller
Financial Services Director

- END OF SECTION -

ATTACHMENT B

GENERAL CONDITIONS, PUBLIC UTILITIES

Index to Articles

ATTACHMENT B
GENERAL CONDITIONS, PUBLIC UTILITIES

CITY OF HOLLYWOOD, FLORIDA
GENERAL CONDITIONS
FOR CONSTRUCTION CONTRACTS

ARTICLE 1 - DEFINITIONS

In the interpretation of these Contract Documents the following terms shall have the meaning indicated:

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 (OWNER) - The City of Hollywood, Florida.

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.

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.

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.

ARTICLE 2 - 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 3 - MISCELLANEOUS PRELIMINARY MATTERS

3.1 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.

3.2 Submissions:

Unless indicated otherwise in the Contract Documents, within seven days subsequent to the CONTRACTOR executing and submitting the required documents of Article 2.13 in Section II - Special Terms and Conditions, 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.

3.3 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.

3.4 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 Attachment C – Supplementary General Conditions, Section 1, Project Schedule as modified by any subsequent Change Orders, Unless the CONTRACTOR fails to complete the requirements of Section II - Special Terms and Conditions, 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.

3.5 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.

3.6 Commencement of Work:

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

3.7 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.

3.8 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.

3.9 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.

3.10 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.

3.11 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 Owner 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.

3.12 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.

3.13 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 Attachment C - Supplementary General Conditions 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.

3.14 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.

3.15 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 40 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.

3.16 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.

3.17 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 4 - CONTRACT DOCUMENTS

4.1 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 in order to produce the intended result shall be supplied whether or not it is specifically called for.

4.2 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. Section I - Introduction
3. Section II – Special Terms and Conditions
4. General Terms & Conditions
5. Attachment C- Supplementary General Conditions
6. Attachment B - General Conditions
7. Division 1, General Requirements
8. Technical Specifications
9. 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

4.3 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 5 - BONDS AND INSURANCE

5.1 Bid Guarantee:

Bidders maybe required to submit a Bid Guarantee in an amount indicated in the SECTION II - SPECIAL TERMS AND CONDITIONS. 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.

5.2 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.

5.3 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.

5.4 Insurance Coverage:

Within ten days from Notice of Award the CONTRACTOR shall purchase and maintain such insurance as specified in Article 2.25 of Section II – Special Terms and Requirements 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.

5.5 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.

5.6 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 - AVAILABILITY OF LAND; REFERENCE POINTS

6.1 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.

6.2 Permits:

When required by Article 2.16 of the Section II – Special Terms and Conditions, 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.

6.3 Lines and Grades:

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

ARTICLE 7 - CONTRACTOR'S RESPONSIBILITIES

7.1 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.

7.2 Indemnification of City:

(a) Refer to ARTICLE 1.46 – INDEMNIFICATION AND HOLD HARMLESS AGREEMENT of Section IV – General Terms and Conditions.

(b) Refer to ARTICLE 1.47 – PATENT AND COPYRIGHT INDEMNIFICATION of Section IV – General Terms and Conditions.

(c) The provisions of (a) and (b) above shall survive the expiration or earlier termination of the Contract Documents.

7.3 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.

7.4 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.

7.5 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.

7.6 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.

7.7 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.

7.8 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.

7.9 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.

7.10 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, in so far 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.

7.11 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.

7.12 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.

7.13 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.

7.14 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 Owner 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.

7.15 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.

7.16 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.

7.17 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.

7.18 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.

7.19 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.

7.20 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.

7.21 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.

7.22 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.

7.23 Indemnification:

In consideration of the amount listed in the Bid Form 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 Owner 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 Bid Form. The Contractor shall acknowledge the receipt of payment and other good and valuable consideration from the Owner 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 8 - CITY'S RESPONSIBILITIES

8.1 Communications:

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

8.2 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.

8.3 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.

8.4 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

9.1 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.

9.2 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.

9.3 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.

9.4 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.

9.5 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

10.1 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.

10.2 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.

10.3 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.

10.4 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, expediters, 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.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 CONSUL T ANT 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."

10.5 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.**

10.6 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.

10.7 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.

10.8 Cancelled 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.

10.9 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

11.1 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.

11.2 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

11.3 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.

11.4 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.

11.5 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.

11.6 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.

11.7 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.

11.8 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

12.1 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.

12.2 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.

12.3 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 therefor in accordance with Article 10.2 and Article 11.2.

12.4 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.

12.5 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.

12.6 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.

12.7 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.

12.8 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

13.1 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.

13.2 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.

13.3 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 2.13 of the Section II – Special Terms and Conditions. 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.

13.4 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.

13.5 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.

13.6 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.

13.7 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 5%.

13.8 Retainage:

The amount of retainage with respect to progress payments will be 5% until completion of the construction services purchased pursuant to the Contract.

13.9 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 12.8.

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.

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

14.1 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 ten (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 sixty (60) 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.

14.2 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 14.1 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 OWNER will accept responsibility for the protection and maintenance of all such items or portions of the WORK described in the written notice.

14.3 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 owners, 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.

14.4 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.

14.5 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.

14.6 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.

14.7 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.

14.8 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).

14.9 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 14.4 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

15.1 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 ninety (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.

15.2 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).

15.3 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 ninety (90) days by the CITY or under an order of court or other public authority, or the CITY fails for sixty (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.

- END OF SECTION -

ATTACHMENT C

SUPPLEMENTARY GENERAL CONDITIONS

INDEX TO ARTICLES

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:

Major Milestones	Completion Time (Calendar Days)	Liquidated Damages (Per Day)
Substantial Completion	**330**	
Project Closeout	**30**	

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.

(1)Substantial Completion

1. Refer to Attachment B - 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 construction work associated with the specific “Major Milestone” listed in the construction work schedule including completion of punch list items. “Completion of punch list items” shall be as determined by the Engineer in the field.

   - Coating touchup completed.

   - Record shop drawings and O&M submittals received and accepted by the Engineer.

   - Record drawing red-lines received and accepted by the Engineer.

   - 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.

(2)Project Closeout

1. Refer to Division 1 General Requirement, Section 01700 Project Closeout.

2. Project Closeout shall also include:

   - All requirements of substantial completion met plus the following
   - Site cleanup and restoration completed
   - All other sitework 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. <u>Insurance Requirements (Not Used. Refer to ARTICLE 2.25 of SECTION II – SPECIAL TERMS AND CONDITIONS OF THE CONTRACT DOCUMENTS</u>

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:

Major Milestones	Completion Time (calendar days)	Liquidated Damages (Per Day)
1. Substantial Completion	**330**	
2. Project Closeout	**30**	

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 $/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.

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 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 of 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

A. The CONTRACTOR shall be responsible for ensuring payment of the rate of wages and fringe benefits, or cash equivalent, for all laborers, mechanics and apprentices employed by him/her or his/her SUBCONTRACTORS on the work covered by this contract which shall be not less than the prevailing rate of wages and fringe benefits payment 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 issued the invitation for bids for this project (the prevailing rate of wages and fringes can be obtained at website http://www.access.gpo.gov/ davisbacon).

If the General Wage Decision fails to provide for a fringe benefit rate for any worker classification, then the fringe benefit rate applicable to such worker classification shall be the fringe benefit rate that has a basic wage rate closest in dollar amount to the work classification for which no fringe benefit rate has been provided.

B. Upon commencement of work, the CONTRACTOR and all of his/her SUB-CONTRACTORS shall post a notice in a prominent place at the work site stating the requirements of this Article.

C. As per the City of Hollywood Code of Ordinances, Prevailing Wage Requirements and Fringe Benefits are applicable to the following: (A) Utilities projects over $1,000,000.00 (one million dollars) and (B) All other projects over $500,000.00 (five hundred thousand dollars).

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. Owner's Contingency (NOT USED)

This allowance is in its entirety dedicated for the use of the Owner (The City of Hollywood) to address conditions (or work) associated with undefined conditions. All work resulting from undefined conditions shall be authorized in writing and in advance by the Owner, specifically the Director of Public Services, through the full execution of a Field Order. The actual amount to be paid per Field Order will be negotiated and agreed by both parties (the Owner and the Contractor). The final/negotiated amount of the field order will be deducted from the Owner's Allowance designated in the Bid Proposal and Schedule of Values. The Owner reserves the right to award none, any portion of, or all of the money associated with this allowance. By executing the CONTRACT between the City of Hollywood and the Contractor, the Contractor acknowledges that under no circumstances he or she should assume that he or she would be entitled to any amounts set aside by the City of Hollywood within the Owner's Allowance.

CERTIFICATE OF SUBSTANTIAL COMPLETION

PROJECT: **ENGINEER:**

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, Public Utilities 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**

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 -

ADDENDA - SECTION 00900

SECTION 13253 – PACKAGED MODULAR ODOR CONTROL SCRUBBER SYSTEM

PART 1 – GENERAL

1.01 SCOPE

A. Design, furnish, install, test, adjust, and place in satisfactory operation one (1) low-profile Modular Odor Control Chemical Scrubber (System) at the location shown on the Drawings and as specified herein. The System shall consist of a multi-stage FRP chemical scrubber, exhaust fan, demisters, nozzles, internal media, recirculation pumps, chemical storage tanks, pre-fabricated skid-mounted chemical feed system, exhaust stack, water softener system, control panel, and all necessary instrumentation and accessories required for a complete and operational System.

B. System work covered by this Specification is intended to be standard equipment of proven reliability and as manufactured by reputable Odor Control System Suppliers (OC Supplier). To ensure complete coordination of all components and to provide system responsibility, all equipment furnished under this section shall be the undivided responsibility of the OC Supplier.

C. All equipment located within three (3) feet of the odor control ductwork, odor control system, and exhaust fan, under positive pressure, shall be explosion-proof rated to NEC Class I, Division 2, Group D.

D. All equipment provided, guy wires and fasteners, and associated anchorage and tie-down systems, shall be designed for wind loading per the latest edition of the Florida Building Code. Wind loading shall be based on a wind speed of 180 MPH, exposure category C.

1.02 OPERATING CONDITIONS AND PERFORMANCE REQUIREMENTS

System	Design Criteria
Quantity of Modular Scrubbers:	1
Air Flow Rate:	1,150 cfm
Average Inlet H_2S Concentration:	500 ppmv
Peak Inlet H_2S Concentration:	1,200 ppmv
Reduced Sulfur Compound Concentration	1.5 ppmv
Minimum Scrubber Removal Efficiency (H_2S and RSCs):	99.5%
Maximum Vessel Footprint:	9.8 ft x 7.33 ft
Scrubber System Pressure Loss, maximum:	8.0 inches w.c.

System	Design Criteria
Ambient Temperature Limits:	30°F to 130°F
No. of Fans:	1
FRP Fan Capacity:	1,150 cfm
FRP Fan Static Pressure:	10.0 inches w.c.
Stage 1 Recirculation Pump Capacity (max):	30 gpm
Stage 2 Recirculation Pump Capacity (max):	30 gpm
Stage 3 Recirculation Pump Capacity (max, if required):	30 gpm
Stage 1 Caustic Metering Pump Capacity:	5 gph
Stage 2 Caustic Metering Pump Capacity:	5 gph
Stage 2 Hypochlorite Metering Pump Capacity:	50 gph
Minimum Metering Pump Discharge Pressure:	50 psi

1.03 RELATED WORK SPECIFIED ELSEWHERE

A. DIVISION 01 – APPLICABLE SECTIONS

B. SECTION 09900 – PAINTING

C. SECTION 11000 – EQUIPMENT GENERAL PROVISIONS

D. SECTION 13252 – FRP DUCTWORK

E. SECTION 15000 – BASIC MECHANICAL REQUIREMENTS

F. DIVISION 16 – APPLICABLE SECTIONS

G. DIVISION 17 – APPLICABLE SECTIONS

1.04 SUBMITTALS

A. Submit the following information 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. List of at least five similar installations of the System type, capacity, odor loading, and location conditions being proposed, including date installed, contact name, address and phone number.

2. Dimensioned drawings of entire System specific to the proposed site and including all components, showing assemblies, arrangements, piping, valves, sizes of field connections and controls. Include operating and dry weights.

3. Dimensioned drawings of pre-fabricated, skid-mounted chemical feed system specific to the proposed site, showing assemblies, metering pumps, arrangements, piping, valves, and all accessories.

4. Dimensions of each chemical storage tank, and dimensions, location, and orientation of openings, fittings, accessories, attachments, restraints and supports, manways, and flexible connections specific to the proposed site.

5. Submit color chart describing the available colors for the vessel exterior pigment color to be selected by the Owner.

6. Materials of construction for all equipment including FRP equipment resin and interior coating descriptions for equipment interior surfaces.

7. Certified performance characteristics for both air and chemical performance of the equipment being provided. List air pressure drop and chemical consumption at specified design conditions.

8. The media supplier shall submit actual operating data from previous installations to substantiate performance claims, specifically: pressure drop, liquid holdup, flooding points, and mass transfer rate (HTU or KGA).

9. Calculations verifying sizing of recirculation pumps, chemical metering pumps, pump performance, chemical storage tanks, and equipment data.

10. Complete motor nameplate data as defined by NEMA.

11. Complete instrumentation, control, logic, and power wiring diagrams. Instrumentation and control component data. Control panel front and rear panel layouts.

12. Certification from OC Supplier of applicable wind load design for vessel and chemical tanks in accordance with current edition of the Florida Building Code.

13. Complete design calculations for the FRP vessel, signed and sealed by a Registered Professional Engineer in the State of Florida.

14. Anchor and tie-down system design calculations for the vessel, fasteners for exhaust stack guy wire system, and chemical tanks, signed and sealed by a Registered Professional Engineer in the State of Florida. Shall include, but not be limited to, anchor calculations for design of fastening tanks and System to concrete pad to withstand applicable wind load criteria and other loadings discussed herein, such as tank flotation. Shall include size, embedment, and

installation design criteria for anchor bolts, tie downs, and exhaust stack guy wire system.

15. Written instructions as to the recommended methods for unloading, storing, and installing the fiberglass vessel and chemical storage tanks and recommended lifting and handling procedures.

16. Complete handling, storage, installation, and adjustment instructions and recommendations.

17. Performance Affidavit, Guarantee, and Warranty.

18. Performance testing procedures and results.

19. Detailed instructions for pipe connections and bolt torque values.

20. Chemical storage tank wall thickness calculations per ASTM D 1998 using 600 psi design hoop stress @ 100°F.

21. A complete manufacturer's specification of the resin used for chemical storage tanks provided.

22. Factory test report for chemical tanks provided, including wall thickness verification, fitting placement verification, visual inspection, impact test, gel test, and hydrostatic test.

23. Statement that materials, resin, and fittings used for the chemical tanks are suitable for intended service.

24. List of recommended spare parts.

25. The following motor data shall be provided:

    a. Name and manufacturer
    b. Type and model
    c. Bearing type and lubrication
    d. Horsepower rating and service factor
    e. Temperature rating
    f. Full load rotative speed
    g. Net weight
    h. Efficiency at rated load
    i. Full load current
    j. Overall dimensions

26. In addition, submit the following data for all recirculation pumps provided:
    a. Name of manufacturer.
    b. Type and model.
    c. Rotative speed.
    d. Size of suction and discharge nozzles.

e. Net weight of pump only.
f. Net weight of baseplate and couplings.
g. Performance curves showing capacity versus head, net positive suction head (NPSH) required, efficiency, and brake horsepower (BHP).

B. Operation and Maintenance Manuals in accordance with 01300, Submittals.

1. In addition to the normal Installation, Operation and Maintenance Manuals required by contract, a spare manual shall be shipped with the unit in order to allow for proper operation of equipment prior to release of all final Installation, Operation and Maintenance Manuals to the end user.

2. Operation and Maintenance Manuals shall each include fully commented and cross-referenced printouts of the final program and printouts of the Operator Interface screens, showing the functionality of each object on the screens.

C. OC Supplier's report of satisfactory installation and field operational tests.

D. Certificate of Conformance as required under Quality Assurance.

1.05 QUALITY ASSURANCE

A. OC Supplier's Qualifications: The work covered by this Specification is intended to be standard equipment of proven reliability and as manufactured by reputable manufacturers having a minimum of ten (10) years of experience in the production of packaged, low-profile odor control chemical scrubbers. The equipment furnished is to be designed, constructed, and installed in accordance as shown on the Contract Drawings and operated per OC Supplier's recommendations. The OC Supplier shall show evidence of at least five (5) similar design installations of the capacity of 1,000 cfm or larger, and with H_2S inlet concentrations greater than 500 ppm, in satisfactory operation in wastewater treatment plants or wastewater pumping stations for at least 3 years. Provide Owner's name, project location, and contact information.

B. The Contractor is responsible for the successful startup and testing of the System. Provide all necessary facilities, manpower, chemicals, tools, instrumentation, and laboratory testing services required to properly install, adjust, and place in operation a working system.

C. OC Supplier's Certifications: Certificate of Conformance: Furnish a notarized letter/certificate, signed by a corporate officer of the OC Supplier, stating that the design of the equipment meets the design and operating criteria specified in paragraph 1.02 and will meet the performance requirements specified in paragraph 1.02. Shop drawings will not be reviewed unless accompanied by the Certificate of Conformance.

D. NEMA Compliance: Motors and electrical accessories to comply with NEMA standards.

E. Electrical Component Standard: Components and installation to comply with NFPA 70 “National Electrical Code”.

1.06 OC SUPPLIER’S RESPONSIBILITY

A. The OC Supplier shall be responsible for coordination of the design and fabrication of the odor control System specified herein and as shown on the Drawings.

B. The OC Supplier shall coordinate and review installation procedures under other Sections and coordinate the installation of items that must be installed to comply with the requirements of the Work specified under this Section.

C. Provide the services of a qualified manufacturer’s technical representative in accordance with Section 01650 – Equipment Testing and Plant Startup and Section 11000 – Equipment General Provisions. Field services shall include the following site visits:

1. At least one (1) trip of four (4) days to check and supervise the installation of the System (including the media), supervise functional testing, supervise initial startup and operation, and instruct the City’s personnel in proper operation and maintenance of the equipment. Training session shall include both classroom and field training.

2. At least one (1) trip of two (2) days for performance testing, in addition to the start-up, functional testing, and training trip.

D. Any additional time required to achieve successful installation and operation shall be at the expense of the Contractor.

E. A written report covering the representative’s findings and installation approval shall be provided directly to the Engineer covering all inspection and outlining in detail any deficiencies noted. Written report shall state that the System has been properly installed and tested to the OC Supplier’s satisfaction and that all required final adjustments have been made.

F. The times specified exclude travel time to and from the facility and shall not be construed as to relieve the OC Supplier of any additional visits to provide sufficient service to place the equipment in satisfactory operation.

G. The OC Supplier and the Contractor shall be responsible for any license fees that may apply to this system.

1.07 WARRANTY

A. The odor control vessel, media, and media support system shall be warranted for a period of ten (10) years from final acceptance.

B. All System components shall be warranted free of manufacturing defects for a period of 12 months from Substantial Completion, or 18 months from equipment delivery to site, whichever occurs first.

PART 2 – MATERIALS

2.01 ACCEPTABLE OC SUPPLIERS

A. Subject to compliance with the requirements of this Section, the following OC Suppliers have the capability of manufacturing the work in this Section:

1. Evoqua Water Technologies.

2. ECS Environmental Solutions.

3. Or Approved Equal.

B. The naming of an OC Supplier in this Section is not an indication that the OC Supplier's standard equipment is acceptable in lieu of the requirements of this specification. Naming is only an indication that the OC Supplier may have the capability of engineering and supplying a system as specified. System shall adhere to the requirements of this specification.

2.02 OVERALL SYSTEM REQUIREMENTS

A. The System is to consist of a complete pre-piped, pre-wired, and packaged construction System including an integral absorber with a minimum of two (2) separate packed bed counter-current scrubbing stages – each with its own sump, mist eliminator, and recirculation pump – three (3) chemical metering pumps, fan, chemical storage tanks, water softener system, piping, valves, fittings, ductwork, control panel, and all other equipment, instrumentation, and accessories as specified to provide a complete and functioning system.

B. General Process Description:

1. Foul air enters the system at the bottom of the first stage (counter current) of the scrubber. Scrubbing solution is sprayed onto the top of the packing to create a large liquid-gas interface surface area. The odor-causing components are absorbed by the scrubbing liquid.

2. The air passes through a mist eliminator, exits the first stage and passes through an internal duct baffle to the bottom of the second stage. Scrubbing solution is sprayed on top of the media in the second stage.

3. If required, the air passes through a third stage and scrubbing solution is recirculated to the top of the media in the third stage.

4. The treated, odor-free air exits the scrubber after passing through a final mist eliminator.

5. Scrubbing solution accumulates in a sump at the bottom of each stage to be recycled through the scrubber packing. A small amount of the scrubbing solution is wasted through the overflow connection in the sump. The amount of scrubber liquid wasted is controlled by adding water to each sump at a continuous rate.

C. All wetted parts must be corrosion resistant to the recirculation scrubbing liquid.

D. No metallic wetted parts are allowed except for internal bolting constructed of Hastelloy C unless otherwise indicated.

E. Unless otherwise specified, all fasteners and metal attachments, such as anchors, brackets, etc. shall be 316 SST.

F. The sizes and capacities of the equipment components listed herein establish minimum requirements only – manufacturer is responsible for verifying sizing for the system furnished to meet the design criteria.

G. All equipment shall be furnished with motors such that the motor shall not be overloaded throughout the full range of operation, unless otherwise specifically approved by the Engineer.

H. The 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 related electrical equipment (conduit, wires, starters, etc.) at no additional cost to the City.

2.03 MODULAR ODOR CONTROL SCRUBBER

A. General: The System is to be a multi-stage, once through packaged chemical absorber. The System is to consist of at least two vertical counter-current gas absorption sections. The packed bed sections are to include a spray header to distribute the liquid evenly over the packing. The treated airflow is to pass through a high efficiency mist eliminator prior to discharge from each stage. The System is to be equipped with a minimum of two self-contained sumps.

1. Scrubber orientation and interconnecting ductwork shall be as shown on the Drawings.

2. Provide access manways in the scrubber to allow access to the internals. At a minimum, provide access manways at the top and bottom of the packing sections, chemical sumps, and the mist eliminator area.

3. The system is to include all piping, valves, and internals. The materials of construction of the internal components are to be as follows:

Packing Media Support:	Vinyl Ester FRP grating
Packing Media:	Polypropylene
Liquid Distributor:	PVC
Spray Nozzles:	Polypropylene
Mist Eliminator:	Polypropylene

4. Recirculation pumps shall be mounted on the Scrubber vessel. The System is to be pre-piped, pre-wired, and shipped as a single unit. Control panel and chemical metering pumps shall be mounted as shown on the Drawings.

B. All equipment is to conform to applicable sections of the following standards except where otherwise specified herein.

1. NBS PS 15-69 – National Bureau of Standards Voluntary Product Standard "Custom Contact Molded Reinforced Polyester Chemical Resistant Process Equipment".

2. ASTM D883 – "Definition of Terms Relating to Plastics"

3. ASTM D2583 – "Test for Indentation Hardness of Rigid Plastics by Means of Barcol Impressor."

4. ASTM D2563 – "Recommended Practice for Classifying Visual Defects in Glass Reinforced Plastic Laminate Parts."

5. ASTM D4097-01 (2010) – "Standard Specifications for Contact Molded Glass Fiber Reinforced Thermoset Resin Corrosion Resistant Tanks."

6. ASTM C582-09 – "Standard Specifications for Contact Molded Reinforced Thermosetting Plastic (RTP) Laminates for Corrosion-Resistant Equipment."

C. Materials of Construction:

1. The scrubber absorber vessel and accessories shall be contact molded manufactured in accordance with NBS PS 15-69, ASTM D 4097 for contact molding.

2. Any visual defects shall be better than Level II on the inside and outside of the vessel in accordance with ASTM D2563.

3. Any material of construction other than FRP with premium grade vinyl ester resin will not be allowed.

4. Vessel wall thickness shall be as required by structural design but not less than ¼ inch.

5. Reinforcement: Glass fiber reinforcement used shall be commercial grade corrosion resistance borosilicate glass.

    a. All glass fiber reinforcement shall be Type C chemical grade, Type E electrical grade.

    b. Surfacing veil shall be 10 mil Nexus 111-00010 or equal.

    c. Mat shall be Type "E" (electrical grade) glass, 1 1/2 oz. per sq. ft with a nominal fiber length of 1.25 $\pm$ 0.25 inches, with a silane finish and styrene soluble binder.

    d. Continuous glass roving, used in chopper gun spray-up applications shall be type "E" grade with chrome or silane coupling agent.

    e. Woven roving used for reinforcement shall be 24 oz. per sq. yard type "E" glass and have a 5 x 4 plain weave.

6. Miscellaneous:

    a. Stainless Steel: Unless otherwise specified, all fasteners, and metal attachments, such as anchors, brackets etc shall be ANSI 316SS.

    b. Gaskets: Unless otherwise specified, all gaskets shall be full-face, 1/8-inch thick, EPDM gaskets of 60 durometer.

D. Fabrication:

1. General: Fabrication shall be in accordance with NBS PS 15-69 and ASTM D-4097. All non-molded surfaces shall be coated with resin incorporating paraffin to facilitate a full cure of the surface. The resin used in the corrosion barrier and structure layers shall be a premium vinyl ester type, fire-retardant with Class 1 flame spread rating, such as Hetron™ FR922 or Derakane™ 510A as manufactured by Ashland Composites, a subsidiary of INEOS; Vipel® F010 as manufactured by AOC Resins; or pre-approved equal. The resin shall be suitable to exposure of hydrogen sulfide fumes at the design concentrations. All cut edges, bolt holes, secondary bonds shall be sealed with a resin coat prior to the final paraffinated resin coat. All voids to be filled with a resin paste.

2. Corrosion Liner: The inner surface of all laminates shall be resin rich and reinforced with NEXUS 111-00010 with a minimum thickness of 10 mils. The interior corrosion

layer shall consist of two layers of 1 1/2 oz. per sq. ft. chopped strand mat. If the application is by chopper gun spray up the glass fiber shall be 1/2 to 2 in length. The total corrosion liner thickness shall be a minimum of 100 mils and have a resin to glass ratio of 80/20. All edges of reinforcement to be lapped a minimum of one inch. Corrosion liner shall be cured using BPO/DMA technique.

3. Structural Laminate: Structural laminates shall consist of alternating layers of 1-1/2 oz per sq. ft mat or chopped glass and 24 oz per sq. yard woven roving applied to reach a minimum 100-mil thick corrosion barrier. Actual laminate sequences shall be per the laminate tables shown on fabrication drawings. The exterior surface shall be relatively smooth and shall have no glass fibers exposed. The exterior shall be surface coated with white gel coat containing ultraviolet light inhibitors.

4. All cut edges, bolt holes, secondary bonds shall be sealed with a resin coat prior to the final paraffinated resin coat. All voids to be filled with a resin paste. No thixotropic or other additives shall be used.

5. Vessel components shall be preassembled at the point of fabrication. Preassembly will not require all joints to be factory assembled, but all joints shall be prepared for field fabrication and square within plus or minus 3/16 inch. Each matched piece shall then be numbered correspondingly.

E. Accessories:

1. Air inlet, air exhaust, pump connections, spray headers, baffles, packing support, drain, level connections, access for mist eliminator and all connections shown on the drawings, or required, shall be provided by the OC Supplier.

2. Tie-Down Lugs: Integrally molded into the walls of the sump.

3. Anchor Bolts: 316 SST and designed for the specified loads.

4. Flanges:

   a. Liquid Service: Per ANSI Std B 16.9

   b. Air Ducts: Duct flanges per PS 15-69 Table 2.

   c. Access Flanges for manways, mist eliminator, and packing access are to be air-tight to the pressure equal to or higher than the corresponding fan static pressure and water-tight.

5. Fasteners attached to the vessel top/corners for attachment to a stabilizing guy wire system to support discharge stack, deigned to meet the Florida Building Code and as required by OC Supplier’s design calculations.

6. Interior Fasteners: Corrosion resistance materials such as FRP.

F. Mist Eliminator: Provide a high efficiency, chevron-type mist eliminator at the discharge of each scrubbing stage. The mist eliminator is to remove 99% of all mist particles 40 microns and larger and 90% of all mist particles 10 microns and larger.

G. Mist Eliminator Wash System: Provide a liquid distributor system with nozzles and isolation valve to manually spray dilute hydrochloric acid for mist eliminator and packing washing for each stage.

H. Shipping: Except for the fan, inlet transition, exhaust stack, and the connection of the stages, design, fabricate, factory assemble and ship the System to the job site as a single piece or a single skid-mounted unit.

I. Piping: All chemical, recycle, make-up water, drain and blowdown piping is to be SCH 80 CPVC.

J. Neoprene Pad: Provide a 1/4” thick, 60 durometer neoprene rubber sheet to be placed underneath the scrubber vessel.

K. Scrubbing Liquid Distribution Header: The header shall be made of Schedule 80 CPVC or FRP and be of the manufacturer's design. Nozzles and material shall be suitable for the use with the recirculation liquid (including non-potable water). Nozzles shall be non-clog, single piece design. The header shall be located above the packing and shall consist of a uniformly distributed full bed diameter single spray, with no moving parts. Multiple spray systems with pipe lateral type distributors located above the packing will also be acceptable. The distributor piping shall be constructed with screwed connections capable of disassembly. Spray nozzles shall be easily removable from the exterior of the tank for cleaning.

L. Exhaust Stack: Manufactured of FRP and provided to the elevation shown on the Drawings with a high-velocity discharge nozzle. Stabilizing guy wires shall be provided to support discharge stack with fasteners attached to the vessel top/corners, as required by OC Supplier’s design calculations. The stack shall include an integral transition from the scrubber outlet rectangular flange to the round duct. The exhaust shall be manufactured similar to the vessel as described in Parts 2.03.C and 2.03.D.

M. Packing Support: Provide fiberglass grating suitable for supporting scrubber packing under all conditions of operation, including a flooded bed condition. Permanently attach grating or grating support to the scrubber wall by lapping with fiberglass and resin. Coat any cut fiberglass edges with the same premium resin used for the FRP supports. No bolting or metal fasteners will be allowed. Packing support open area is to be greater than 80 percent of the total cross section.

N. Packing:

1. Type: Non-clogging, non-nesting type, capable of being dumped onto the scrubber grating without causing physical damage. Provide sufficient packing to fill the bed

to a depth within ±2” of the design after 90 percent of expected settling has occurred.

2. Material: Polypropylene

3. Size: 3.5” or 4.0” diameter.

4. Maximum Pressure Drop: 0.20 inches of water column per foot of packing.

5. Manufacturer: Tri-Packs as manufactured by Jaeger, Inc., Lantec Lanpac XL, or equal.

2.04 FIBERGLASS REINFORCED PLASTIC (FRP) FANS

A. Provide fire-retardant, radial fume exhauster-type fans composed of FRP with an epoxy or UV gel coating to protect against ultraviolet degradation. Fans shall be installed complete with motors, drives, guards, and coatings of sufficient capacity for the duty required. Fans shall operate to draw odorous air from the process areas shown and shall exhaust air through the System.

1. The fans shall use a V-belt drive, arrangement as shown, equipped with a slip inlet, drilled outlet flange, Teflon shaft seal, 316 SST shaft, fan guard, and motor enclosure.

2. Fans shall be factory-fabricated and assembled, factory-tested, and factory-finished with indicated capacities and characteristics.

3. Basis of fan performance shall be at standard conditions (density of 0.075 lb/ft3).

4. Selected fans shall be capable of accommodating static pressure and flow variations of +/-15% of scheduled values.

5. Fans shall be equipped with lifting lugs.

6. Nameplate: Each fan shall be furnished with a permanently affixed Type 316 stainless steel nameplate with manufacturer’s name, model number, serial number, and electrical data.

7. Mounting: The entire fan and motor assembly shall be mounted on vibration isolators to reduce noise transmission.

8. Rotating Assembly: Rotating assembly shall be statically and dynamically balanced to balance grade G6.3 per ANSI S2.19 and designed for continuous operation at the maximum rated fan speed and motor horsepower.

B. Fan shall be constructed such that all surfaces in contact with the corrosive gas stream are made of solid, corrosion-resistant FRP. All nuts, bolts, and fasteners in contact with the gas stream shall be Type 316 stainless steel and encapsulated in FRP.

C. Manufacturer: Manufactured by The New York Blower Company, Hartzell, or Ceilcote/Verantis.

D. Performance: Fan ratings shall be based on tests made in accordance with AMCA Standard 210. Fans shall be licensed to bear the AMCA Certified Ratings Seal for Air Performance. Fans not licensed to bear the AMCA Seal for performance shall be tested, at supplier's expense, in an AMCA Registered Laboratory. Fans shall have a sharply rising pressure characteristic extending throughout the operating range to assure quiet and stable operation. Fan speed and motor size shall be selected by the OC Supplier to meet the required conditions of air flow rate and pressure drop across the biological odor control System and ducting, including the pressure drop in the ducting upstream of the biological odor control System inlet. Fan speed shall not exceed 85% of the maximum allowable driven speed of the fan.

E. Motor: Motor shall be selected by fan manufacturer and designed to meet the requirements listed in Paragraph 1.02. Provide motor with an adjustable base for varying belt tension and belt alignment. Motor shall meet the requirements specified in the table below.

	Exhaust Fan
Rating	480V, 3 ph, 60 Hz
Horsepower (max)	5.0
Speed, max rpm	1,800
Enclosure	TEFC, Suitable for Class I, Div 2 Environment
Insulation	Class H
Inverter Duty	No
Service Factor	1.15
Space Heater	No
Motor Winding Temperature Switches	No
Drive	Constant

F. Sound: Fan manufacturer shall provide sound power level ratings for fans tested and rated in accordance with AMCA Standards 300 and 301. Sound power ratings shall be in decibels (reference lOE-12 watts) in eight (8)-octave bands.

G. Bearings: Bearings shall be grease-lubricated, precision anti-friction ball, self-aligning, pillow block design. Bearings shall be designed for a minimum L10 life of 30,000 hours

(150,000 hours L50 life) when rated at the fan's maximum cataloged operating speed. Fan bearings shall be visible and accessible for inspection and maintenance. Bearings enclosed within the fan housing where they can be exposed to the corrosive gas stream are not acceptable.

H. Construction: Fan shall be constructed in accordance with the ASTM D-4167 standard specification for FRP fans and blowers to ensure structural integrity. All surfaces exposed to the atmosphere shall be rich in paraffinated resin, shall be stabilized against ultraviolet degradation, and shall include a reinforcement not to exceed 20% “C” grade fiberglass. All parts exposed to the foul air stream shall be constructed of, or encapsulated in, an FRP laminate capable of resisting continuous airstream temperatures of 250 degrees Fahrenheit. All resins shall be clear to allow detection of subsurface imperfections. Use of pigments, gel coats, inhibitors, and additives which may disguise flaws in the laminate is prohibited.

1. Housing: Fan housing shall be constructed of a fire-retardant polyester resin or Type II PVC with an ASTM E84 Class I rating. Housing laminate construction shall conform to ASTM Standard C-582. Airstream surfaces shall be smooth to minimize resistance and prevent buildup of airborne contaminants. Shaft hole openings shall be fitted with a Teflon closure having a maximum clearance of 1/32-inch to minimize leakage. A flanged inlet and flanged outlet composed of FRP construction shall be furnished on the fan. Inlet assembly shall be bolted to permit wheel removal. Fan shall be furnished with an access door, positioned to avoid collection of condensation, and a 1-inch minimum flanged type drain connection, positioned at the lowest portion of the fan scroll.

2. Wheel: Wheel shall be backwardly-inclined, single thickness type. Wheel blades shall be airfoil-type blades, which limit load horsepower characteristics so the motor provided with each fan does not exceed the maximum design motor horsepower. Non-overloading design for increased efficiency. Wheel shall be fabricated of a fire-retardant vinyl ester resin with an A8TM E84 Class II rating no greater than 30. Wheel hub shall be permanently bonded to the shaft and completely encapsulated in FRP to ensure corrosion resistant integrity. Steel wheels coated with FRP or wheels with taper-lock hubs are not acceptable.

3. Shaft: Shaft shall be Type 316 stainless steel, with an FRP sleeve fixed securely and bonded to the wheel backplate. The sleeve shall extend out through the housing shaft hole for corrosion protection. The shaft first critical speed shall be at least 125% of the fan's maximum operating speed. Shaft shall be counter-sunk for tachometer readings.

I. Belt Drives:

1. Belt drive components shall be sized based on a service factor of 1.4.

2. Pulleys shall be of the fully-machined cast iron-type and shall be keyed and securely attached to the wheel and motor shafts. Motor pulleys shall be adjustable for final balancing.

3. Belts: Oil-resistant, non-sparking, and non-static.

4. Belt drives shall be factory-mounted with final alignment and belt adjustment made after installation.

5. Belt Guard: Provide an OSHA-compliant belt guard composed of FRP on the outside of the fan cabinet. Belt guard or motor cover shall to completely cover the motor pulley and belt(s).

J. Balance and Run Test: The wheel and shaft shall be dynamically balanced on precision balancers. Prior to shipment, completed fans shall receive a final test balance at the specified operating speed.

K. Final Inspection: All fans shall receive a final inspection by a qualified inspector prior to shipment. Inspection shall include fan description and accessories, balance, welding, dimensions, bearings, duct and base connection points, paint finish, and overall workmanship.

L. The fan and motors shall be factory-mounted on a structural channel subbase with integral motor slide base.

M. Expansion joints shall be provided at the fan inlet and exhaust connections. Expansion joints shall be in accordance with Section 13252, FRP Ductwork.

2.05 RECIRCULATION PUMPS

A. A recirculation pump shall be provided for each sump. Operating Conditions and Performance Requirements for Recirculation Pumps shall be as described in Paragraph 1.02 above.B. The recirculation pump shall be a seal-less, rugged, vertical, centrifugal type pump of CPVC, polypropylene or BPO/DMA cured fiberglass construction for corrosion resistance and long service life. No seal water shall be required. The pump shall be suitable for solutions with a pH of 14. Recirculation pumps shall be Vanton SUMP-GARD SGK, Fybroc 7500 Series, or equal.

C. Pump shall have a stainless steel one-piece rotor drive shaft covered with a one-piece CPVC, polypropylene or FRP sleeve and impeller. There shall be no liquid to metal contact, no seals, no pump bearings, bushings or wearing parts. The pump shall be mounted for easy service on the scrubber system sump.

D. Pump impeller shall be located in the submerged casing. Pump shall be provided with cantilevered shaft, no bearings immersed in the process fluid and dry running capability.

E. All units shall be statically and dynamically balanced throughout, and an analysis of the pump and motor shall be performed to ensure that there are no frequencies of vibration that form harmonic resonance between them as a unit in operation. The vibration allowance in the units shall not exceed 4 mils at any point on the unit while running

within 15 percent above or below the design point on the curve using the head or gpm for which the units have been designed to function.

F. Radial and thrust ball bearings shall be provided, which shall safely carry all radial and thrust loads. The bearings shall be of the antifriction, grease or oil lubricated, ball or roller type in a dustproof housing. The bearing frame shall be of rigid construction to support the shaft. Bearings shall have an ABMA L10 life of 100,000 hours.

G. A non-metallic vapor seal shall be provided to protect the metal motor bracket from corrosive fumes.

H. Recirculation pump capacities and motor horsepower shall be as specified herein and verified by the OC Supplier for proper flow rate and pressure as required for installation. Pump sizing calculations shall be submitted to the Engineer for review.

I. The pump shall be furnished with an all plastic fabricated strainer basket with ¼" diameter perforations in same to keep any large particles out of the casing or impeller area.

J. Motors shall be manufactured by WEG, Siemens, Tatung, or approved equal. Motors shall meet the following requirements:

Rating	480V, 3 ph, 60 Hz
Maximum Horsepower	2.0
Speed, rpm	1,800
Enclosure	TEFC (Class 1, Div 2)
Insulation	Class F
Inverter Duty	No
Service Factor	1.15
Space Heater	No
Motor Winding Temperature Switches	No

2.06 CHEMICAL FEED SYSTEM

A. The chemical feed system is to be designed for 50% sodium hydroxide and 12.5% sodium hypochlorite and is to dilute and deliver the chemical solution from the chemical storage tanks to the spray nozzles where it is circulated through the packing media.

B. Provide a pre-fabricated, skid-mounted chemical feed system. The chemical feed system shall contain all piping and equipment necessary to deliver chemicals from sodium hypochlorite and sodium hydroxide storage tanks to the scrubber vessel.

C. Skid manufacturers shall be Blue Planet Environmental Systems, Inc., Prominent or equal.

D. The Contractor shall be responsible for the following:

1. Providing and installing required interconnecting piping between the storage tanks and the skid-mounted chemical feed system and from the skid-mounted chemical feed system to the chemical scrubber.

2. Providing and installing the wiring between the pumps and the system control panel.

E. Chemical Metering Pumps:

1. Chemical metering pumps shall meet the Operating Conditions and Performance Requirements provided in Paragraph 1.02 above and shall be suitable for continuous, 24 hour per day, 365 day per year operation.

2. Metering pumps shall be positive displacement, non-lost motion, mechanical diaphragm type, Wallace and Tiernan model Encore 700 series, or equal model as manufactured by Prominent, Pulsafeeder, or Milton Roy.

3. Motors for the chemical feed pumps are to be brush type, permanent magnet, constant torque, DC motors with the following features:

a. Enclosure: TENV, corrosive duty, suitable for Class I, Division 2 environment

b. Insulation: Class H insulation with Class B temperature rise, 40C ambient.

c. Permanently lubricated double shielded ball bearings.

d. Motors 1.0 HP and below shall be rated for continuous duty at 90 VDC. Motors larger than 1.0 HP shall be rated for continuous duty at 180 VDC.

e. Motors shall be sized so that at no time during any operating condition shall the torque required by the pump exceed that available continuously from the motor.

f. Stroke frequency shall be controlled through speed adjustment of the variable speed, constant torque, DC motor drive. The SCR Control Unit controlling the motor speed shall consist of an electronic switching amplifier, SCR full wave rectifier and associated circuitry; specifically designed for use with constant torque motors. Closed loop speed regulation through a feedback tachometer input shall provide feed rate control accurate to ±0.1% of full scale. SCR control unit shall be remote mounted.

4. The stroke frequency adjust mechanism, driven by a direct coupled, SCR drive DC motor, shall actuate a convex-shaped or flat, teflon-faced composite diaphragm. Solenoid driven pumps will not be accepted.

5. Stroke length shall be controlled manually via a 10-turn micrometer-type adjuster. A percent scale and vernier shall indicate stroke length in 0.25% increments. Each revolution of the knob shall change stroke length by 10%.

6. The OC Supplier is responsible for the coordination of corrosion resistant materials for the chemical solutions specified. The OC Supplier shall include all features as necessary for satisfactory operation of the pumping systems for chemical solutions specified. Pumps, motors, and accessories shall be coated with a heavy duty protective epoxy coating resistant to the specified chemical to prevent corrosion.

7. The metering pumps shall be provided with an oil-lubricated gear reducer and cam-and-spring drive mounted in an aluminum or epoxy-painted cast iron housing. The housing shall be sealed into an outer plastic housing for corrosion protection with heat sink fins for cooling.

8. The liquid ends shall include cartridge-type ball check valves. Conventional threaded valves will not be allowed. Valve service or removal shall not require any disturbances to the pump head pipeworks.

9. The liquid end shall be physically separated from the drive unit by a back plate with weep hole creating an air gap. An elastomer shaft wiper seal or secondary diaphragm shall prevent contamination of the gear box if the primary diaphragm fails.

10. The pump and motor shall be mounted on a common base. The motor shall be direct coupled to the gear box.

11. Each pump and motor shall have a corrosion resistant nameplate giving the manufacturer's model, serial number, rating, range, speed, and other pertinent data.

12. SCR drives shall be located in the System control panel.

13. Acceptable materials of construction shall be as follows:

	Sodium Hydroxide [Caustic] (50%)	**Sodium Hypochlorite [Hypo] (12.5%)**
Diaphragm	PTFE faced EPDM with Steel Core	PTFE faced EPDM with Steel Core
Housing Material	Glass-filled Luranyl	Glass-filled Luranyl
Liquid End Material	PVC	Kynar
Ball Check Valve	PVDF with PTFE faced Viton Gasket Seals	PVDF with PTFE faced Viton Gasket Seals

	Sodium Hydroxide [Caustic] (50%)	Sodium Hypochlorite [Hypo] (12.5%)
Ball Check Valve Balls	Ceramic	Ceramic
O-Ring Seals	Teflon (PCTFE), Hypalon, Buna-N	Teflon (PCTFE), Viton
Hardware	316 SS	Hastelloy C or Titanium

F. Metering Pump Skid Assembly:

1. All metering pump accessories shall be provided by the metering pump manufacturer and installed on a pre-fabricated skid which houses both the sodium hypochlorite and the sodium hydroxide chemical metering pumps.

2. Each pump shall have the ability to function as an isolated pump (i.e., independent of piping and operation of the other pumps mounted on the skid assembly).

3. Pumps shall be provided as skid mounted chemical metering pump systems complete with the skid assembly containing chemical metering pumps, all necessary piping, valves, fittings, supports, electrical controls, and accessories as specified herein. The metering pump skid shall contain the following items:

    1. Metering pumps – all 120 V / 1 phase
    2. Calibration columns
    3. Pulsation dampeners (discharge)
    4. Pressure gauges (indicators) with diaphragm seals
    5. Isolation valves
    6. Pressure relief valves
    7. Backpressure valve
    8. Suction side strainers
    9. Flushing connections with isolation ball valves on both suction and discharge side piping

    12. Power and Signal wiring pre-wired junction box

4. All piping, valves, gaskets, supports, hardware, wiring, junction boxes, and accessories necessary for a fully functioning skid. Piping shall be terminated within 2 inches from the edge of skid. All piping within the skid shall be installed with a minimum of 3 inches spacing between all fittings to facilitate repairs. Sodium hypochlorite skid piping shall be built with an inverted suction manifold. Electrical cables shall terminate in the pre-wired termination panel.

5. The chemical feed system shall be completely assembled by the Skid Manufacturer, mounted, calibrated, tested, and delivered to the site on a single

skid. Components to be mounted on the skid shall include, but not be limited to, the metering pumps, calibration column, piping, valves, piping accessories (pulsation dampeners, etc.), and wiring integral to the skid. The Skid Manufacturer shall be responsible for providing all equipment, valves and piping within the skid boundary

6. The skid shall be constructed of a material that is corrosion resistant to the chemical service as recommended by the skid manufacturer and suitable for long term service. The skid shall have adequate supports for all equipment and piping. Anchor bolt holes shall be provided. The skid should be of an open style with a removable front splash shield. The skid shall be suitable to be mounted on top of an FRP grating table.

7. Accessories shall be connected to piping with flanged ends (not threaded).

8. Pressure gauges: See Paragraph 2.13, Item F.8 for details. Gauges shall be provided on the discharge of metering pumps. Each gauge shall have a range of zero to 100 psi. Each gauge shall be provided with a diaphragm seal, constructed of materials which are completely resistant to corrosion by the chemicals referred to in this Section. Each pressure gauge shall also be provided with an isolation valve. Isolation valves shall be PVC with seals that are resistant to the chemical applications.

9. Pressure Relief Valves:

    a. Provide pressure relief valves in the discharge piping.

    b. Pressure relief valve body shall be constructed of PVC or other material resistant to the process chemicals and compatible with the operating pressures. Diaphragm shall be of Hypalon/PTFE construction.

    c. Pressure relief valves shall have a built-in priming valve, fully adjustable setting via external screw, and piping connections of a size as to accommodate the pump discharge piping.

    d. The valve shall be set at a relief pressure that is 90 percent of the maximum design discharge pressure.

    e. Sizing of the valves shall be the responsibility of the OC Supplier and calculations shall be submitted with Shop Drawings.

10. Antisiphon / back pressure valves: Valves shall be manufactured by the pump manufacturer and shall be completely resistant to the chemicals for which they are provided. Sizing of the valves shall be the responsibility of the manufacturer and calculations shall be submitted with Shop Drawings.

11. Pulsation Dampeners: Diaphragm and body materials and configuration shall be supplied for the specific chemical for which the dampener is used without corrosion, wear, or other cause of abnormally short life. Each dampener shall be equipped with a charging valve and gas pad pressure gauge rated at 0 to 150 psi. Sizing of the pulsation dampeners shall be the responsibility of the manufacturer, and calculations shall be submitted with Shop Drawings.

12. Calibration Columns:

    a. Provide calibration columns in the suction piping. Each calibration column shall be furnished with a valve and schedule 80 PVC or CPVC (as applicable) nipple for connection to the suction piping.

    b. The capacities of the calibration columns shall be 2,000 cc.

13. Skid pipe shall be CPVC Schedule 80. CPVC shall be Class 23447-B or better, conforming to specification ASTM D1784 and ASTM F441/F441M. Cement shall be as recommended by the pipe manufacturer for the service outlined in this Section.

14. Vented ball valves shall be utilized for sodium hypochlorite service. The valves supplied under this specification shall meet the requirements of the Section entitled “Ball Valves”. Isolation valves shall be provided at all equipment connections.

2.07 DUCTWORK

A. The odor control system manufacturer shall provide all necessary ductwork, expansion joints, dampers and supports from the fan inlet to the chemical scrubber vessel exhaust. Ductwork and ancillary components shall meet the requirements of Section 13252, FRP Ductwork.

2.08 WATER SOFTENER

A. Provide a pre-assembled, skid-mounted, combination water softener and reverse osmosis unit using ion exchange resin to pre-treat the scrubber’s make-up water hardness.

B. Model shall be Vantage PTC Series Twin Softener manufactured by Evoqua Water Technologies, LLC, or, Culligan, Soft-Minder Twin Plus, Model SMS-91, or approved equal, and shall be rated as required by the OC Supplier.

C. The water softener shall have a flow capacity at least equal to the maximum required make-up water rate and shall be capable of removing hardness to no more than 1 grain/gallon. The unit shall be 115-volt, single phase (10 watts). The complete water softener system shall consist of one control valve, two mineral tanks, one

electromechanical meter, one extra cam and switch, and connecting pipe between vessels and resin. Recommended inlet pressure of 30-100 psig.

D. Each mineral vessel shall be a corrosion resistant composite, constructed of a polyethylene shell wound with continuous fiberglass fibers. Each vessel shall be supplied with high-capacity cation exchange resin. Each vessel shall include an inlet diffuser to evenly distribute the influent water, to collect backwash water and to introduce the brine regeneration solution.

E. One of the two mineral vessels shall be fitted with a top-mounted, five-cycle multiport control valve to operate the backwash, brining, slow rinse, fast rinse and refill cycles. An additional piston assembly shall be included to control the duty/standby status of the two vessels. A brass control valve including fixed and self-adjusting flow regulators shall be provided. A hydraulically balanced Teflon coated piston shall be provided to perform the cycles of regeneration.

F. A single salt storage tank shall be provided as part of the softener system. The salt storage tank shall be constructed of corrosion resistant polyethylene. The brink tank shall be equipped with an automatic air eliminator safety valve which shall be attached to the brine line and housed within a chamber inside the brine tank. The brine valve shall automatically open to educt the brine into the softener tank, close to prevent eduction of air, and refill the brine tank with the proper amount of water.

G. Water softener system shall be provided with NEMA 4, UL-rated controls and a fused power distribution panel with disconnect switch and a single electrical connection.

H. System shall be controlled with an SXT programmable controller. This controller shall include a power backup system that continues to keep time for a minimum of 48 hours in the event of a power failure. The system configuration shall be stored in a non-volatile memory, maintained with or without power, indefinitely. Regeneration shall be set initiated by three methods: totalized volume (immediate or delayed)., programming (time clock or day of week), or via the operator manually initiating the regeneration.

2.09 POLYETHYLENE STORAGE TANKS

A. Provide cross-linked high-density polyethylene storage tanks for 50% sodium hydroxide and 12.5% sodium hypochlorite.

B. Conditions of Service/Storage Tank Schedule:

	Sodium Hypochlorite Bulk Tank	**Sodium Hydroxide Bulk Tank**
Number of Tanks	One (1)	One (1)
Material	Polyethylene	Polyethylene
Max Solution Concentration	12.5%	50%

	Sodium Hypochlorite Bulk Tank	Sodium Hydroxide Bulk Tank
Specific Gravity	1.2	1.15
Freezing Point	-17°F @ 12.5%,	54°F @ 50%
Design Temperature	35-120 degrees F	35-120 degrees F
pH	13	14
Type	Vertical, Cylindrical	Vertical, Cylindrical
Bottom Configuration	Flat Bottom	Flat Bottom
Top Configuration	Dome Top	Dome Top
Useable Capacity (to invert of overflow, minimum)	3,000 gallons	850 gallons
Maximum Diameter	7'-6"	4'-0"
Maximum Straight Shell Height	8'-11"	9'-1"
Maximum Overall Height	10'-2"	10'-0"
Connection Openings*:		
1) Fill Line	2"	2"
2) Metering Pump Suction	1"	1"
3) Drain Line	2"	2"
4) Overflow Line	3"	3"
5) Vent	4"	4"
6) Manway Diameter (Top)	1'-4"	1'-4"
7) Radar Level Instrument**	Yes	Yes
8) Sight Gauge**	¾"	¾"
Heating Panels and Insulation Design Temperature / Minimum Ambient Temperature	No	Yes
Materials of Construction for Metal Components in Containment Area	Hastelloy-C/Titanium	Hastelloy-C/Titanium
Materials of Construction for Metal Components above Containment Area	316 Stainless Steel	316 Stainless Steel
Materials of Construction for Elastomers	Viton	EPDM
Containment Wall Height	Refer to Drawings	Refer to Drawings
Exposure	Outdoors	Outdoors

** Refer to Drawings for Location, Orientation, and Elevation of Connections*

	Sodium Hypochlorite Bulk Tank	Sodium Hydroxide Bulk Tank

** *Coordinate with Instrument Supplier*

C. Tanks are to conform to applicable sections of the following standards except where otherwise specified herein.

1. The work of this section shall comply with the most current edition of the Florida Building Code.

2. American National Standards Institute (ANSI)

   a. ANSI B16.5 – Pipe Flanges and Flanged Fittings.

3. American Society of Testing Materials (ASTM)

   a. ASTM D638 – Standard Test Methods for Tensile Properties of Plastics.

   b. ASTM D746 – Brittleness Temperature of Plastics and Elastomers by Impact.

   c. ASTM D790 – Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.

   d. ASTM D883 – Standard Definitions of Terms Relating to Plastics.

   e. ASTM D1505 – Density of Plastics by the Density-Gradient Technique.

   f. ASTM D1525 – Vicat Softening Temperature of Plastics.

   g. ASTM D1693 – ESCR Spec. Thickness .125” F50-10% Igepal.

   h. ASTM D1998 – Standard Specification for Polyethylene Upright Storage Tanks.

D. Acceptable Manufacturers: The polyethylene storage tank(s) shall be as manufactured by Assmann Inc., Snyder Industries, Poly Processing Company, or approved equal.

E. Materials and Construction:

1. Each tank shall be one-piece construction, rotationally molded, high-density cross-linked polyethylene. Tank shall have a specific gravity rating of 1.5 and shall be completely resistant to corrosion by the specified chemicals. The Contractor and tank manufacturer shall be fully responsible for the structural design and integrity and watertightness of the tank, including all anchorages and connections. Each

tank shall be capable of storing the specified chemical at temperatures up to 130°F.

2. The plastic shall not contain any fillers. All plastic shall contain a long-term UV stabilizer.

3. The nominal properties of the material are as follows based on molded parts:

Property	ASTM Specification	Value
Density	D1505	0.943 to 0.946 g/cc
ESCR Condition A, F50 100% Igepal 10% Igepal	D1693	 F_0 > 1,000 hours F_0 > 1,000 hours
Tensile Strength at Yield 2 in/min	D638	2,700 – 2,900 psi
Elongation at Break 2 in/min.	D638	640 percent
Flexural Modulus	D790	110,000 psi
Impact Strength, -40 °C	ARM	450 ft-lbs
Deflection Temperature @ 66 psi	D648	157 °F

4. Design Requirements

   a. The minimum required wall thickness of the cylindrical shell at any fluid level shall be determined by the following equation but shall not be less than 0.187 in thick.

T	=	P x O.D./2 SD = 0.433 x S.G. x H x O.D./2 SD
T	=	wall thickness
SD	=	Hydrostatic design stress, PSI
P	=	pressure (.433 x S.G. x H), PSI
H	=	fluid head, ft.
S.G.	=	specific gravity, g/cm∧3
O.D.	=	outside diameter, in.

   b. The hydrostatic design stress shall be determined by multiplying the hydrostatic design basis, determined by ASTM D2837 using rotationally molded samples, with a service factor selected for the application. The hydrostatic design stress is 600 PSI at 73 degrees Fahrenheit.

c. The hydrostatic design stress shall be derated for service above 100 degrees Fahrenheit and for mechanical loading of the tank.

d. The standard design specific gravity shall be 1.5.

e. The minimum required wall thickness for the cylinder shell must be sufficient to support its own weight in an upright position without any external support.

f. For dome top tanks, the top head must be integrally molded with the cylinder shell. The minimum thickness of the top head shall be equal to the top of the straight wall. For open top tanks, the open top shall include a reinforcing flange provided for attaching a flat, hinged top. The minimum thickness of the flat top shall be equal to the top of the straight wall.

5. All tank capacities (volumes) specified shall include only that volume in the straight shell below the maximum tank fill level (below the overflow pipe invert elevation) and above the top of the outlet pipe. At least four inches of freeboard shall be provided between the top of the overflow pipe and the top of the straight shell.

6. Tanks shall be anchored to the concrete base by the Contractor in accordance with the Drawings. Tanks shall be designed to withstand flotation, assuming that the containment area is in a flooded condition and the tank is empty.

7. The tanks shall be cylindrical and vertical in orientation with tank penetrations as indicated on the Contract Drawings.

F. Connections and Accessories:

1. All connections/openings shall be flanged in accordance with ANSI B 16.5 150 pounds. Flanged connections, nozzles and openings shall be perpendicular to the straight shell of the tank. All required pipe supports, hardware, accessories, etc., shall be provided. All piping connected to the tanks shall be perpendicular or parallel to the straight shell of the tanks. All piping into the tanks shall be supported such that no weight is placed on the tank and its connections.

2. Each tank connection located on the lower third of the tank shall be provided with a flexible connector resistant to the specified chemical to allow for lateral and vertical expansion and contraction of the tank and to isolate the tank from pump and piping vibration. Flexible connectors shall be provided by the tank manufacturer.

3. Integrally Molded Flange Outlet: The tank discharge connection for below liquid installation shall be an integrally molded flange outlet. The flange outlet shall be of the same material as the tank. The flange outlet shall allow for full drainage of the tank. The external flange shall be ANSI Class 150 with a socket end. Hardware shall be Hastelloy C-276.

4. Sidewall fittings above the chemical fill level shall be Schedule 80 PVC or CPVC bulkhead fittings. Sidewall fittings below chemical fill level shall be as follows:

   a. Sodium Hydroxide: Bolted flange PVC or CPVC with either polyethylene- or EPDM-encapsulated bolts, or bolted one-piece polyethylene with backing ring designed to reduce stress on the fitting.

   b. Sodium Hypochlorite: Hastelloy C-276.

5. Threaded Bulkhead Fittings: Provide threaded bulkhead fittings for above liquid installation for fittings up to two inches in diameter. Tank wall thickness shall be considered for bulkhead fitting placement and the maximum wall thickness for each fitting size is shown below:

Fitting Size	Maximum Wall Thickness (inches)
1/2 inch	0.750
3/4 inches	0.875
1 inch	0.875
1 1/4 inches	0.875
1 1/2 inches	0.875
2 inches	1.0

6. Opening for pump suction line and drain line outlet shall be integrally molded full drain outlet. Bolts and gaskets shall be constructed of materials as specified.

7. Connections at the top of the tank shall be self-aligning flanges or bulkheads fitting when required for plumbing or instrument installation. Fittings shall be constructed of CPVC with Viton gaskets. Hardware shall be Hastelloy C-276.

8. Vent lines shall be top-mounted. Each vent shall be extended to the atmosphere and shall have a PVC vent insect screen. Vent lines shall be supplied and installed by the Contractor as shown on the Drawings or as directed by the Engineer.

9. Tank fill lines shall be as shown on the Drawings. All pipe supports, hardware, accessories, etc., shall be provided. Vertical piping into the tanks shall be supported every five feet and shall be parallel to the tank wall and not less than 6 inches from the tank wall.

10. Fill Station: Each storage tank fill line shall be provided with a cam lock type quick connect coupling with downstream ball valve as shown on the Drawings for connection to the delivery vehicle. The dry quick connections shall be resistant to corrosion by the specified chemicals and shall be provided with fittings, quick lock

coupling and dust cap and chain. Quick connect couplings shall be provided by the Contractor as specified in Section 15000 – Basic Mechanical Requirements. The Contractor shall furnish and install a sign at each chemical fill station to identify the chemical filled. The signage shall be as specified in Section 10400 – Identifying Devices.

11. Each tank shall be provided with an overflow pipe as specified and indicated on the Drawings. The Contractor shall provide a Flange Insert Check Valve (FIV) for each overflow pipe. The FIVs shall be complete with unions, liquid traps, and flanges. The valves shall be flanged check valve type inserted between two mating flanges. The valves shall be the same size as the tank overflow line. Each valve shall have a cracking pressure of 1/2 psig. The valve bodies shall be constructed of PVC, and valve seats and metal springs shall be as specified. The flange insert valves shall be as manufactured by Check-All Valves Manufacturing Company, or equal.

12. Level Sensor Mounting Provisions: Each tank shall be provided with a minimum 4 inch diameter flanged nozzle with a blind flange for mounting a radar level transducer in accordance with Division 17. The radar transducer shall be mounted with a bracket attached to the blind flange, as shown on the Instrumentation Detail Drawings. The mounting and connecting requirements, required clearance between mounting flange and tank wall, and height above liquid level, shall be coordinated with the Division 17 Instrument Supplier.

13. Manway: Each tank shall be provided with a top-mounted chemically resistant manway with gasket and bolt-on type cover. Materials of construction shall be as specified for the chemical to be stored.

14. Sight Level Gauge Provisions: Each tank shall be equipped to allow for installation of a visual liquid level gauge furnished by the Division 17 Instrumentation Supplier under Section 17690 “Sight Level Indicators”. The mounting and connecting requirements shall be coordinated with the Division 17 Instrumentation Supplier.

15. Access Ladder: Each storage tank shall be equipped with an exterior access ladder for access to the manway(s) at the top of the tank. Ladder shall be constructed of FRP. Ladder shall meet OSHA requirements. Ladders shall be furnished with all required mounting hardware, accessories, anchor bolts, bands, base brackets, etc. for a complete installation. Mounting hardware shall be Hastelloy C. Angle clips shall be furnished for mounting the bottom of the ladder to the concrete pad. Ladders shall be furnished with gooseneck handrails at the top. The tank top shall be equipped with ladder clips to bolt ladder handrails thereto.

16. Lifting Lugs: The tank shall be provided with a minimum of three lifting lugs. Lifting lugs shall be capable of withstanding weight of an empty tank with a safety factor of 3 to 1.

17. Tie Down Lugs, Tie Down Cables and Anchor Bolts: Each tank shall be provided with a restraint system with necessary cable assemblies, anchor clips and anchor bolts. Anchor clips shall be 316 stainless steel, and cables shall be stainless steel. Anchor bolts shall be completely resistant to corrosion by the specified chemicals. Restraint system shall withstand wind load calculated in accordance with current Florida Building code, and buoyancy of empty tank in a containment area flooded to the top of the containment wall. Refer to Drawings for containment wall height. Anchor clips requiring holes through the side wall of the tanks shall not be allowed.

    a. The anchor clips and cables shall be designed and supplied by the tank manufacturer.

    b. The anchor bolts, nuts, washers, shims and related hardware shall be sized and provided by the Contractor. The Contractor shall size the anchor bolt anchoring depth and edge distance for the tank pad.

    c. Submit calculations, sealed by a Professional Engineer in the State of Florida, to verify that tie-down lugs and anchor bolts can withstand buoyancy and wind loads.

18. The tank shall be provided with a permanently attached label providing the following information:

    a. Name, concentration, and specific gravity of material stored

    b. Tank resin

    c. Tank dimensions and capacity

    d. Maximum temperature rating of tank

    e. Manufacturer

    f. Date of manufacture

19. All metallic parts, fasteners, brackets, mounting hardware, and accessories provided by the tank manufacturer shall be constructed of corrosion resistant metals as specified in the Tank Schedule.

G. Piping support:

1. All horizontal sections of piping inside the containment area and trench shall be supported by thermoplastic pads at maximum 5-foot intervals as shown in the Drawings to prevent the piping from resting directly on concrete.

2.10 ACCESSORIES

A. Make-up Water Control: The direct reading rotameter shall be a variable area type with a Teflon float, EPR “O” rings, and PVC fittings. The rotameter shall be of the same size as the pipe in which it is installed. The rotameter shall have a direct reading scale.

B. Scrubber Recirculation Sump Blowdown and Level Controls: The scrubber shall be operated with a manual blowdown. The rate of blowdown shall be proportional to the rate of make-up water.

C. Overflow Control: An overflow line equipped with an internal water seal shall maintain a minimum freeboard of four inches as measured from the maximum liquid level to the top of the scrubber sump deck.

2.11 PAINTING

A. All paint and coatings shall be shop applied in accordance with Section 09900 – Painting unless approved by the Engineer. Any painted surfaces that are damaged during handling, assembly, shipping, storage, and installation shall be cleaned, scraped back to soundly adhering paint, and repainted to equal the original painting received at the shop.

2.12 EQUIPMENT IDENTIFICATION

A. Each piece of equipment shall be provided with a substantial stainless-steel nameplate, securely fastened in a conspicuous place and clearly inscribed with the manufacturer’s name, year of manufacture, serial number and principal rating data.

2.13 ELECTRICAL, INSTRUMENTATION AND CONTROLS

A. General:

1. Furnish a complete operating control system for local and automatic control and remote monitoring of the System as specified in this Section. Panels shall be mounted as shown on the Drawings. Provide control panel and field instruments as described below.

2. A complete Odor Control System PLC panel, LCP-33, shall be furnished by the Section 13253 Odor Control Scrubber System supplier and integrated into the existing WWTP SCADA HMI and Historian by the Division 17 instrumentation and controls subcontractor. In addition to the LCP-33 panel and internal hardware, the local OIU-33 HMI graphic screens and PLC-33 logic shall be furnished by the Odor Control System Supplier. The Odor Control Scrubber System supplier’s scope of supply shall include the equipment and strategies shown on the Instrumentation Drawings. The Odor Control Scrubber System supplier shall be fully responsible for all PLC-33 logic programming, OIU-33 graphics programming and LCP-33 managed Ethernet switched configuration both prior to shipment of the panel and once the panel has been installed in the field and energized. Odor Control Scrubber System supplier shall coordinate with the CITY’s ICE department to

obtain the CITY's preferred IP addresses for PLC-33, OIU-33 and the LCP-33 managed Ethernet switch.

3. The CITY's preferred systems integrator/panel builders are as follows:

    a. C.C. Controls – Location: West Palm Beach, Florida Phone: (561) 293-3975

    b. Revere Control Systems – Location: Lakeland, Florida Phone: (863) 646-5781

4. Provide terminal junction wiring boxes on each modular odor control unit.

5. Junction boxes shall be made of materials rated for the area classification and for material compatibility with the chemicals contained within the scrubber module.

    a. All Modular Odor Control mounted instruments shall be installed in and wired to the junction box for connection to the remotely mounted LCP. Junction Box shall be sized so that all Modular Odor Control mounted equipment can be installed in and wired to the junction box.

    b. Provide a minimum of 15% spare terminals.

    c. Separate 460 volt wiring from 120volt wiring.

    d. Separate intrinsically safe wiring from all other wiring.

    e. Provide a separate terminal box for analog and low voltage signal wiring.

B. Odor Control System Local Control Panel (LCP):

1. In addition to the requirements described herein below, the LCP (LCP-33) shall meet or exceed the requirements of the Instrumentation Detail Drawings and the following Division 17 Sections:

    a. 17120, 17180, 17190, 17500, 17550, 17560, 17900, 17910, 17920

    b. LCP-33 shop drawing submittals shall meet section 17030 requirements

    c. Provide operator training per Section 17040 requirements

2. System shall be provided with a local control panel (LCP) as described herein. LCP shall have a single point of connection to 480 VAC, 3-phase power and shall be furnished with a main circuit breaker. Provide a main power supply disconnect circuit breaker rated 480 VAC, 65 kAIC. Additional circuit breakers shall be provided in the circuits of the system major pieces of equipment. The panels shall include all necessary circuit breakers and protective devices including lightning surge suppressors. The panel main breaker shall be sized to feed all equipment

and devices associated with the odor control systems as specified here in and indicated on the drawings.

3. LCP shall house all electric and electronic components required to monitor and control the operation of the system. Panels shall contain all motor controls (circuit breakers, motor starters, etc.) and shall be provided by the OC Supplier. The control panel shall be UL Listed and bear the "UL Listed Enclosed Industrial Control Panel" Label. NEMA rated electrical components shall be provided, IEC rated components are not acceptable.

4. The panel shall be equipped with a Modicon M340 Programmable Logic Controller (PLC) with a 4 port Ethernet/IP communications module and all digital and analog input and output modules required to provide the PLC-33 inputs and outputs required by Section 17920 and as described herein. The PLC shall meets or exceeds Section 17120 requirements.

5. The panel shall be equipped with a touchscreen operator interface unit (OIU-33) that meets or exceeds Section 17125 requirements.

6. The panel shall be equipped with a redundant loop power supply that meets or exceeds Section 17120 requirements.

7. The panel shall be equipped with surge protection devices that meet or exceed Section 17560 requirements.

8. A 120Vac UPS shall be provided for LCP-33 and shall meet or exceed Section 17190 requirements.

9. LCP enclosure shall be a double door, Type 316 stainless steel NEMA 4X panel powder coated white with sunshields as shown on the Instrumentation Detail Drawings. The panel shall be free standing with 12” 316 stainless steel legs and covers, constructed in accordance with UL 508 and UL 698 requirements for enclosed industrial control panels and shall bear the serialized UL label. Hinges, pins, latches and fasteners shall be 316 SST. The enclosures shall have a hinged outer door with suitable 3-point latching mechanisms and continuous gaskets to keep ambient corrosive gases from entering the panel when closed. The panels shall have a hinged inner door fabricated from 5052-H32, 0.080-inch thick-brushed marine alloy aluminum. The inner door shall be completely removable for ease of service. The inner door shall be held closed by mechanical latches. The subpanel shall be degreased, cleaned, treated with a phosphatizing process, then primed and painted with white industrial grade baked enamel. The enclosures and mounting systems shall be designed to withstand wind loads as required by applicable building codes.

10. The panel shall provide power and control for the fan, recirculation pumps, metering pumps, and all components supplied herein.

11. Panels shall be tagged as indicated on the Instrumentation Drawings.

12. All starters for the System equipment, including SCR drives for the metering pumps, shall be located in the LCP.

13. Exhaust Fan motor starter shall be located in the LCP.

14. All non-460 Volt loads shall be powered off an internal power transformer.

15. Main power disconnect circuit breaker device, mechanically interlocked with door so that the main power must be “OFF” before door can be opened.

16. Stainless steel, copper-free aluminum or FRP back panel with provisions to mount control devices and terminal strip for field connections.

17. Provide separate circuit breakers on the 120 VAC power to the following devices external to the panel as necessary:

    a. Division 17 Instrumentation Supplier furnished Radar Level Indicating Transmitters LIT-60011 and LIT-60031

C. Control System Features:

1. Operator Controls and Indications: Provide the following operator controls and indications at each local control panel for each odor control system:

    a. Selector Switches:

        1) Control power ON/OFF (Mounted to LCP inner door)

        2) Odor Control System START-STOP selector switch

        3) SYSTEM RESET Pushbutton

        4) LOCAL/REMOTE

    b. HMI Selector Switches:

        1) Odor Control Exhaust Fan HAND-OFF-AUTO selector switch

        2) Recirculation Pump #1 H-O-A

        3) Recirculation Pump #2 H-O-A

        4) Metering Pump #1 H-O-A

        5) Metering Pump #2 H-O-A

6) Metering Pump #3 H-O-A

c. Local Status Light Indication (Mounted to LCP inner door)

1) Power On

2) Common Alarm

3) System Running

4) System Stopped

d. OIU-33 HMI Screen Status Indication :

1) Power ON

2) Odor Control Exhaust Fan Running

3) Recirculation Pump #1 Running

4) Recirculation Pump #2 Running

5) Metering Pump #1 Running

6) Metering Pump #2 Running

7) Metering Pump #3 Running

8) Sump 1 pH value display

9) Sump 2 pH value display

10) Sump 2 ORP value display

11) Recirculation Pump #1 Failure (amber)

12) Recirculation Pump #2 Failure (amber)

13) Stage 1 Sump Low Level (red)

14) Stage 2 Sump Low Level (red)

15) Stage 1 Sump pH Alarm (amber)

16) Stage 2 Sump pH Alarm (amber)

17) Stage 2 Sump ORP Alarm (amber)

18) Odor Control Exhaust Fan Failure

19) Odor Control Exhaust Fan High Motor Temperature

20) Scrubber Stage 1 to 2 Differential Pressure

21) Scrubber Stage 2 Differential Pressure

22)

e. HMI Indication:

1) Sump 1 pH value display

2) Sump 2 pH value display

3) Sump 2 ORP value display

f. Adjustable Setpoint:

1) Sump 1 pH setpoint

2) Sump 2 pH setpoint

3) Sump 2 ORP setpoint

2. Discrete Inputs to PLC-33 shall be 24Vdc. Provide intrinsic safety barriers as required to meet code requirements.

3. HMI Elapsed Time Meter Display: Include six-digit non-resettable counter values with units in hours for each pump and fan HMI faceplate.

Control System Operation:

4. When the Odor Control Scrubber System Local/Remote selector switch on the LCP-33 inner door is set to Local mode Auto/Manual mode selection and local manual operation of the Odor Control Fan (OCF-60005), Stage 1 Recirculation Pump (RP-60001), Stage 2 Recirculation Pump (RP-60002), Sodium Hydroxide Metering pumps (MP-60011 and MP-60021) and Sodium Hypochlorite Metering pump MP-60031 shall be from OIU-33, remote control from the SCADA HMI shall be disabled. When Odor Control Scrubber System Local/Remote selector switch is set to Remote, control shall be from the SCADA HMI screen and local control from OIU-33 shall be disabled. Remote Auto and Local Auto modes shall utilize the same automatic strategy, described herein below. A faceplate graphic on the SCADA HMI Screen for each metering pump, recirculation pump and the exhaust fan shall allow for Remote Auto and Remote Manual mode selection and remote operation of each device.

5. When the Odor Control Scrubber System START-STOP selector is in STOP position, the System shall not run regardless of other run commands.

6. When the local switch is the START position, the System pumps and fan shall run.

7. Odor Control Exhaust Fan H-O-A selector (HMI Screen)

    a. When the selector is in AUTO, the fan shall run when the modular odor control scrubber is running.

    b. When the selector is in OFF, the fan shall not run.

    c. When the selector is in HAND, the fan shall run.

    In either AUTO or HAND modes, the Odor Control Exhaust Fan shall be shut down when any of the associated alarm conditions occurs (overload, high motor temperature).

8. Recirculation and Chemical Pump H-O-A selectors (HMI Screen)

    a. When the selector is in AUTO, the pumps shall run when the modular odor control scrubber is running.

    b. When the selector is in OFF, the fan shall not run.

    c. When the selector is in HAND, the fan shall run.

    d. In either AUTO or HAND modes, the Odor Control Exhaust Fan shall be shut down when any of the associated alarm conditions occurs (overload, high motor temperature).

9. Sodium Hydroxide Metering pumps, MP-60011 and MP-60021, shall both be duty pumps, with MP-60011 feeding sodium hydroxide to the Odor Control Scrubber Stage 1 Sump and MP-60021 feeding sodium hydroxide to the Stage 2 sump. When the metering pump keypad is set to local mode, the operator shall control metering pump speed from the built-in keypad on the pump. When the metering pump keypad is set to remote mode, the metering pump shall be controlled from PLC-33. An enable and speed reference signal shall be required to operate the pump from PLC-33.

    a. When the Odor Control Scrubber System Local/Remote selector switch on the LCP-33 inner door is set to Local mode Sodium Hydroxide Metering pump, MP-60011 and MP-60021, metering pump Auto/Manual mode selection and local manual operation shall be from OIU-33, remote control from the SCADA HMI shall be disabled. When Odor Control Scrubber System Local/Remote selector switch is set to Remote, control shall be from the SCADA HMI screen and local control from OIU-33 shall be disabled. Remote Auto and Local Auto modes shall utilize the same automatic strategy, described herein below. A faceplate graphic on the SCADA HMI

Screen for each metering pump shall allow for Remote Auto and Remote Manual mode selection for each pump.

b. Remote Auto –When the Odor Control Scrubber System Local/Remote selector switch (on the LCP-33 inner door) is set to Remote and Remote Auto is selected from the SCADA HMI screen for a Sodium Hydroxide pump, the system shall modulate the metering pump speed based on the automatic feed strategy described below.

c. Remote Manual –When the Odor Control Scrubber System Local/Remote selector switch (on the LCP-33 inner door) is set to Remote and Remote Manual is selected from the SCADA HMI screen for a Sodium Hydroxide pump, the system will modulate the metering pump speed based on a SCADA HMI adjustable speed set-point (0-100%).

d. Local Auto –When the Odor Control Scrubber System Local/Auto selector switch (on the LCP-33 inner door) is set to Local and Auto is selected from OIU-33 for a Sodium Hydroxide pump, the system will modulate the metering pump speed based on the automatic feed strategy described below.

e. Local Manual –When the Odor Control Scrubber System Local/Remote selector switch (on the LCP-33 inner door) is set to Local and Manual is selected from OIU-33 for a Sodium Hydroxide pump, the system will modulate the metering pump speed based on an OIU-33 adjustable speed set-point (0-100%). The adjustable speed set-point shall be the same tag in PLC-33 for both OIU-33 and the SCADA HMI.

f. Sodium Hydroxide Automatic Feed Strategy - sodium hydroxide metering pump SCRs shall be modulated to maintain the corresponding sump pH setpoint based on pH indicating transmitter feedback.

10. Sodium Hypochlorite Metering pump MP-60031 shall feed sodium hypochlorite to the Stage 2 sump. When the metering pump keypad is set to local mode, the operator shall control metering pump speed from the built-in keypad on the pump. When the metering pump keypad is set to remote mode, the metering pump shall be controlled from PLC-33. An enable and speed reference signal shall be required to operate the pump from PLC-33.

    a. When the Odor Control Scrubber System Local/Remote selector switch (on the LCP-33 inner door) is set to Local mode Sodium Hypochlorite Metering pump, MP-60031 Auto/Manual mode selection and local manual operation shall be from OIU-33, remote control from the SCADA HMI shall be disabled. When Odor Control Scrubber System Local/Remote selector switch is set to Remote, control shall be from the SCADA HMI screen and local control from OIU-33 shall be disabled. Remote Auto and Local Auto modes shall utilize the same automatic strategy, described herein below. A faceplate graphic on

the SCADA HMI Screen for each metering pump shall allow for Remote Auto and Remote Manual mode selection for each pump.

b. Remote Auto –When the Odor Control Scrubber System Local/Remote selector switch (on the LCP-33 inner door) is set to Remote and Remote Auto is selected from the SCADA HMI screen for a Sodium Hypochlorite pump, the system shall modulate the metering pump speed based on the Odor Control Scrubber System Suppliers' automatic feed strategy.

c. Remote Manual –When the Odor Control Scrubber System Local/Remote selector switch (on the LCP-33 inner door) is set to Remote and Remote Manual is selected from the SCADA HMI screen for a Sodium Hypochlorite pump, the system will modulate the metering pump speed based on a SCADA HMI adjustable speed set-point (0-100%).

d. Local Auto –When the Odor Control Scrubber System Local/Remote selector switch (on the LCP-33 inner door) is set to Local and Auto is selected from OIU-33 for a Sodium Hypochlorite pump, the system will modulate the metering pump speed based on the Odor Control Scrubber System Suppliers' automatic feed strategy.

e. Local Manual –When the Odor Control Scrubber System Local/Remote selector switch (on the LCP-33 inner door) is set to Local and Manual is selected from OIU-33 for a Sodium Hypochlorite pump, the system will modulate the metering pump speed based on an OIU-33 adjustable speed set-point (0-100%). The adjustable speed set-point shall be the same tag in PLC-33 for both OIU-33 and the SCADA HMI.

f. Sodium Hypochlorite Automatic Feed Strategy - sodium hypochlorite metering pump SCRs shall be modulated to maintain the corresponding sump pH setpoint based on ORP indicating transmitter feedback.

11. Bumpless Mode Transition - The transition between Automatic and Manual modes shall be bumpless.

12. System Interlocks - When the local switch is in the START position, the Local Control Panel controls the System based on the inputs from field devices or discrete inputs:

    a. Each low level sump switch shall shut off the recirculation pump and chemical metering pump associated with the sump and provide an alarm.

    b. Upon receiving a low chemical storage tank level, the control system is to stop the associated metering pump(s) from operating and provide an alarm.

13. All alarm conditions are to latch and require that the RESET button on the LCP be pressed to reset the system. The LCP strobe shall activate when an alarm condition is present.

14. Upon loss of power, system control is to reset and restart the system based on control inputs.

D. Electrical Components and Accessories:

1. General: Furnish and install all necessary electrical components, including all conduit, wiring, and terminations for a complete, functional system.

2. Unless otherwise indicated, the control panels shall be dead fronts and the pilot devices shall be mounted internally of the respective enclosures. Pushbuttons, selector switches, and pilot lights shall be 30.5 mm, heavy-duty, oil tight type with provisions to maintain the NEMA ratings of starter enclosures. Legend plates indicating switch positions shall be provided for each pilot device. Pilot lights shall be LED type, push-to-test.

3. Motor Starters: Full voltage, combination type, non-reversing starter with overload relays, control power transformers, reset push-buttons, circuit breaker through-the-panel operators for each motor. Motor starters to be NEMA sized with a minimum size of NEMA 1. The magnetic starter to be of the heaterless design and provide phase loss protection, short circuit self-protection and provide thermal memory. The solid-state overload shall be self-powered. The contactor shall feature double-break silver cadmium oxide contacts, pressure type terminals, arc barriers, free floating armature magnet frame, molded continuous duty coil and stainless steel springs. Starter overload heater coils shall be sized to protect installed motor at full load AMP rating. The motor starters shall be Square D or approved equal.

4. Motor Power and Control Circuit Breakers: Provide breakers for each motor power circuit and a breaker for the 120V power and control circuits. Provide branch circuit breakers for the panel receptacle and light, panel A/C light and 120V control panel as required.

5. Control power transformer to be sized for anticipated loads from devices/controls.

6. Power/Phase Monitor: A power monitor relay shall be installed and connected to the control logic. When the relay is deactivated, it shall disconnect control power to the motor starter. The relay shall be deactivated in the event of phase loss, phase reversal, or low voltage. The phase monitor relay shall be a Diversified Model SLA-440-ASA or equal.

7. Selector switches shall be SPDT, two or three position selector switches. Reset pushbuttons for all motors shall be momentary contact type with black operator. The selector switches and pushbuttons shall be Square D Type SK, A/B type 800H or equal.

8. Lightning/Surge Arrestor: A secondary arrestor, complying with ANSI 62.41 – latest revision, shall be installed on the line side of the main breaker in accordance with manufacturer's instructions. Arrestor shall be intermatic model AG6503C or equal.

9. 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.

10. Pilot devices shall be 30.5 mm heavy-duty nonmetallic NEMA 4X, Square D, Class 9001, Type SK or equal.

    a. Pushbuttons shall be extended guard type. Pushbuttons and selector switches shall be non-illuminated.

    b. Pilot lights shall be LED, push-to-test type. Pilot light lens colors shall be as follows:

        1) Red – "Run", "On", "Open"

        2) Green – "Off", "Closed"

        3) Amber – "Alarm", "Fail"

        4) White – "Control Power On"

11. Electronic Indicators (if used): Electronic indicators shall be 3.5 or 6 digit, as appropriate, with 0.56" high red LED display. Indicators shall be provided with nameplate and scale calibrated to match the calibration of the primary element. The unit shall be designed primarily for use with 4-20 mA current loop signal circuits. Indicator operating voltage shall be 115 VAC 10%, 60 Hz. Indicator controls shall include three (3) front-panel pushbuttons for modifying alarm values and other indicator setup. Two (2) form-C relays shall be provided for each indicator. Relay contact outputs shall be rated 5A, 120/240 VAC, resistive load. Indicators shall be Red Lion Model IMP or APLCL, or equal.

12. Conduits:

    a. Liquid-tight, PVC-coated, non-metallic, flex between fixed conduit and metering pumps and field devices or as otherwise required for Class I, Division 1, Group D hazardous areas. Panel seal-offs to provide terminations on either side of the epoxy-based seal-off material to allow for replacement of cable without breaking the seal.

13. Wiring (Inside Panels):

    a. Control wiring stranded copper, minimum #14 AWG.

    b. Power wiring stranded copper, minimum #12 AWG.

    c. Insulation dual-rated for type THHN and THWN applications.

    d. Power terminals lug-type, 600 V minimum rated, with separate bare copper ground lugs for incoming and pump ground wires.

    e. Control terminals screw type, 300 V minimum rated, with minimum 10% or 6 spare terminals (whichever is greater).

    f. External control wiring terminations to be vinyl-insulated crimp connectors with spade lugs.

    g. Separate analog wiring by at least 6 inches from any AC power and control wiring.

    h. Enclose wiring in sheet metal raceways or plastic wiring ducts.

14. Identification:

    a. Provide legend plates as follows:

        1) Pilot Devices - Aluminum with black background and white letters, mechanically attached with pilot device.

        2) Controlled Device – 1” wide black plastic with 3/8” white engraved lettering, attached with stainless steel screws or epoxy.

        3) Control Panel – 1” wide black plastic with 3/8” engraved white lettering, attached to exterior door with stainless steel screws or epoxy.

        4) Tag all instruments mounted behind panel with embossed plastic tape labels.

    b. Wire Identification:

        1) Wire Tags: Snap-on or slip-on PVC wire markers with legible machine printed markings and numbers. Do not use adhesive or taped-on tags.

        2) Numbered and tagged at each termination.

    c. Color coding shall be as follows:

        1) Power – black

2) Switched hot – red

3) Neutral – white

4) Switched neutral – yellow

5) Ground - green

15. Laminated or etched aluminum “As Built” copy of the panel wiring diagram shall be provided and applied to the inner side of the enclosure door.

16. Terminals: A minimum of one, 10-pole terminal block mounted on a 30-degree angle shall be provided as a minimum for interface with field installed equipment for the ease of field connection. Additional terminal blocks shall be added as needed in 10-pole increments. Terminal blocks shall be mounted with a minimum of 2” from both enclosure sides and a minimum of 1” from the bottom of the enclosure for easy access to the terminal screws.

17. Mounting Hardware: All mounting hardware such as screws or bolts used in the manufacturing of the control panel shall be stainless steel. All holes in the back plate and dead front shall be drilled and tapped. No self-tapping screws, adhesive tapes, or Velcro will be accepted for mounting any hardware.

18. Corrosion protection: Panel interior components shall be treated with a corrosion inhibiting spray on all exposed metallic surfaces, particularly terminations, contacts and wire ends. After installation, furnish corrosion inhibiting capsules that emit molecular level coating on metallic surfaces throughout the panel that provide specific corrosion barrier toward hydrogen sulfide and/or subsequent formation of sulfuric acid when combined with ambient moisture.

E. Field Control Equipment:

1. Devices within the scrubber enclosure shall be rated for Class I, Division 1, Group D hazardous areas.

2. Devices located within a 3 foot envelope of the scrubber, associated ducting, and fans shall be rated for Class I, Division 2, Group D hazardous atmospheres.

3. pH Element/Transmitters shall be provided under this Section and shall be by Hach, YSI or Engineer Approved Equal. Sensors and transmitters shall be rated for sensor operation in Class I, Division 1, Group D hazardous areas.

4. ORP Element/Transmitters shall be provided under this Section and shall be by Hach, YSI or Engineer Approved Equal. Sensors and transmitters shall be rated for sensor operation in Class I, Division 1, Group D hazardous areas.

5. Differential Pressure Indicating Transmitters: Provide a Stage 1 to 2 differential pressure and Stage 2 to Mist differential pressure transmitter per Section 17760 requirements.

6. Level Switches: OC Supplier's standard switch designed for the intended service and corrosion-resistant construction. Provide intrinsically-safe circuits for the level switches.

7. Pressure Gauges shall be liquid-filled, including all-plastic isolators and isolation valves, shall be provided under this Specification Section for installation in the pump discharge piping. The gauges shall have a minimum dial size of 3½ inches. The gauge faces shall indicate units of measurement and the normal operating reading shall be near the midpoint of the range. Each gauge shall be provided with a diaphragm seal constructed of materials which are completely resistant to corrosion by the chemicals referred to in this Section. Each pressure gauge shall also be provided with an isolation valve. Isolation valves shall be PVC with seals that are resistant to the chemical applications.

2.14 TOOLS, SUPPLIES, AND SPARE PARTS

A. Furnish all special tools (one set per like piece of equipment) necessary to disassemble, service, repair, and adjust the equipment.

B. All spare parts furnished with the equipment are to be painted or coated as required in Section 09900 – Painting. Where no painting or protective coatings are specified, suitable provisions are to be made to protect against corrosion.

C. All spare parts are to be identical and interchangeable with the original parts and are to be furnished in clearly identifiable and labeled containers.

D. Provide all spare parts as recommended by the various equipment manufacturers. Include the following at a minimum:

1. One (1) set of gaskets for all gasketed covers and connections.

2. One (1) set of spray nozzles.

3. One (1) spare pH probe.

4. One (1) spare ORP probe.

5. One (1) impeller tool for the recirculation pumps (if applicable).

6. Two (2) spare pressure gauges with diaphragm protectors (for each service)

7. One (1) spare pressure relief valve (for each service)

8. One (1) spare back pressure valve (for each service)

9. One (1) spare pulsation dampener (for each service)

10. One (1) spare parts (i.e., preventive maintenance) kit including all components required to rebuild pump head (one for each pump)

E. All of these materials are to be properly packed, labeled and stored where directed by the CITY.

2.15 EQUIPMENT IDENTIFICATION

A. Each piece of equipment shall be provided with a 16-gauge stainless steel equipment identification plate or label laminated into the final fiberglass coat, in accordance with Section 11000 – Equipment General Provisions, which shall be securely fastened in a conspicuous place and clearly inscribed with the manufacturer's name, date of manufacture, serial number, capacity in cfm, design pressure, resin, minimum thickness, vessel name, etc. as applicable.

PART 3 – INSTALLATION

3.01 QUALITY ASSURANCE

A. Inspection and Testing Requirements: The Engineer reserves the right to reject delivery of any or all pieces of equipment found, upon inspection, to have any or all of the following: blisters, chips, crazing, exposed glass, cracks burned areas, dry spots, foreign matter, surface porosity, sharp discontinuity or entrapped air at the surface of the laminate.

B. Provide the services of an independent FRP Testing Inspector to be present at the point of manufacture, upon completion of fabrication and prior to shipment, to perform or witness the following:

1. Visual inspection to the requirements of ASTM D2563 Level II.

2. Barcol Hardness measurements per ASTM D2583-87.

3. Acetone sensitivity test for all internal secondary bonds.

4. Glass content by ignition loss on three cutouts per ASTM D2584.

5. Hydrostatic leak test: Fill to two (2) feet above vessel sump; allow to stand for 2 hours with no visible signs of leakage.

C. A one (1) inch diameter FRP sample shall be taken at a point on the vessel wall where a penetration or access manway will be located to prevent patching of sample locations. The analysis shall be performed by Ashland Chemical Co. Analytical Services & Technology Group, Dublin, OH, or equal. The analysis shall use FT-IR spectra and a

micro-ATR sampling accessory on a Varian UMA600 IR microscope. The cost of analysis and shipping shall be by the OC Supplier.

D. The Engineer reserves the right to be present at the fabricator's facility for visual inspection of equipment to be supplied. Visual inspection shall be performed prior to application of the exterior UV-resistant gel coat.

3.02 INSTALLATION

A. All equipment shall be assembled and shipped so that field assembly will be minimized and installation can be completed with little or no field fabrication.

B. All parts shall be properly protected so that no damage or deterioration will occur in transit or during prolonged storage at the site. All openings in equipment shall be protected against entry of foreign objects.

C. Each box, crate, and package shall be properly marked to show its contents and net weight.

D. Install the equipment in accordance with the OC Supplier's drawings and instructions. All FRP work shall be protected from atmospheric or otherwise induced conditions of adverse temperatures, moisture, wind, or blowing dust and sand and other contaminants that would adversely affect the laminate or joint construction. The protective means shall be provided during the construction and curing period.

E. Lubricate all equipment and make ready for operation.

F. Upon completion of the installation, each piece of equipment and each system is to be tested for satisfactory operation without excessive noise, vibration, overheating, etc. Compliance shall be based on the equipment manufacturer's specifications and all applicable costs to meet those standards shall be borne by the Contractor. All equipment must be adjusted and checked for misalignment, clearances, supports, and adherence to safety standards.

G. Deliver fans in manufacturer's original unopened packaging with brand name clearly marked and showing to jobsite with sufficient protection, bracing, etc. to ensure arrival in acceptable and undamaged condition.

H. Lift and support units with the manufacturer's designated lifting or supporting points.

I. Store in original containers on level supports and protect materials from damage and exposure to the elements until installed. Do not keep in storage for over 90 days.

J. All cut edges of fiberglass shall be coated with the specified resins prior to installation.

K. All metallic fasteners, brackets, mounting hardware, and accessories located in chemical storage and feed areas shall be constructed of corrosion-resistant metals as specified in the Tank Schedule.

L. All tanks shall be mounted on concrete pads only when demonstrated to be fully cured. The finished surface of each tank bottom shall be sufficiently flat, smooth, and free of irregularities, to prevent the possibility of tank failure from point loads or other sources.

M. The Contractor shall install 2 layers of EPDM between each concrete pad and storage tank, if recommended by the tank manufacturer. The tanks shall be installed on level pads.

3.03 SYSTEM START-UP

A. Start-up and testing of the System shall be performed in accordance with the requirements of Section 01650 – Equipment Testing and Plant Startup and Section 11000 – Equipment General Provisions, and the requirements herein.

B. Complete instrumentation and controls testing in accordance with Sections 17070 and 17072 in coordination with Division 17 instrumentation and controls subcontractor.

C. System start-up shall be performed by the OC Supplier and shall commence only after a visual inspection confirming proper installation by the OC Supplier's representative. OC Supplier shall provide any specialized equipment and materials required during start-up.

D. All testing shall be done in the presence of the Engineer and the OC Supplier or their approved representative.

E. The Odor Control System Supplier shall provide services as follows:

1. Field test and calibrate equipment and demonstrate to the Engineer that all equipment satisfactorily performs as specified.

2. Submit field testing reports and certification of proper installation to Engineer and City.

3. Submit start-up data report to Engineer and City.

4. OC Supplier or OC Supplier's representative shall perform the field tests required.

5. List and recommend corrective action for any deficiencies found.

6. Record inlet air temperature, inlet air relative humidity, inlet airflow rate, media differential pressure, inlet and outlet concentrations of hydrogen sulfide, and other data as may be appropriate.

7. All data shall be submitted to the Engineer and City in written report form. Field testing report shall include, at a minimum, description of testing procedure,

summary of all data collected in tabular form, operational comments, confirmation of compliance with performance requirements, and recommendations/corrective actions (if necessary).

3.04 FIELD ACCEPTANCE TESTS

A. Field acceptance tests are required for the System specified herein within 12 months of delivery of the equipment. All equipment shall be field tested in accordance with the applicable requirements of Section 01650 – Equipment Testing and Plant Startup and Section 11000 – Equipment General Provisions. No performance or field test shall begin until all air flow rates have been adjusted and balanced in accordance with Section 13252 – FRP Ductwork for Odor Control Service. Functional Testing is to include the mechanical tests and performance tests as specified below. Submit information which fully describes the OC Supplier's testing procedure. Provide at least ten days' notice of such tests. Engineer will witness the acceptance tests. In case of failure of any unit to meet the test requirements, make alterations as necessary, and repeat the tests at no additional cost to the City until the equipment is satisfactory. Submit certified report of successful field acceptance and mechanical tests.

B. Mechanical Test - The entire System with other associated equipment such as fans, recirculation pumps, and metering pumps, piping, and controls are to be mechanically tested for at least 4 hours after initial installation. Test is to be made with recirculation scrubber liquid and airflow being introduced at the design flow rates. All equipment is to be mechanically sound, show no evidence of liquid or gas leaks, have no undue vibrations and generally be structurally rigid when being tested.

C. Prior to conducting the Performance Tests, the Contractor shall re-examine the media level and add additional media as required to compensate for any settling of the bed.

D. Performance Test - Field test the System over a period of two (2) days to demonstrate compliance with the design conditions of service. Submit written documentation indicating the proper operation of all system components to the Engineer prior to performance testing. Each performance test shall be witnessed by the Engineer at the Engineer's discretion.

1. At a minimum, the OC Supplier shall furnish the following items:
    a. Portable manometer with a range of 0 to 10 inches W.C. for differential pressure loss across the scrubber media bed (as measured in inches W.C.).
    b. Air velocity meter for airflow measurement (cfm) into the odor control vessel.
    c. Portable H_2S analyzer and data logger (Odalog, AcruLog, or Interscan) for measurement of inlet H_2S gas concentrations. H_2S data logger range of measurement shall be compatible with the design concentrations specified in Part 1.02.
    d. Portable H_2S analyzer (Odalog, AcruLog, or Jerome 631-X) for measurement of exhaust H_2S gas concentrations. H_2S analyzer range of

measurement shall be compatible with the expected exhaust concentrations specified in Part 1.02.

e. Contractor to provide all water, power, labor, and equipment that the Odor Control System Supplier's field engineer requires for conducting the tests.

2. H_2S Test Procedures: Removal of H_2S from the inlet air stream must be greater than or equal to 99.5 percent of the inlet concentration. Each test is to be conducted with a fixed quantity of chemical or chemicals. H_2S inlet and exhaust concentrations shall be continuously measured (maximum 5-minute intervals) and the data logged by the instrument data loggers for a minimum of 24-hours. H_2S sampling methods shall conform to the following standards:

a. Prior to commencing recording exhaust concentration, the system should be allowed to reach concentration equilibrium. Inlet and exhaust H_2S concentrations are to be continuously monitored and recorded using the analyzers as specified herein.

b. Inlet concentration data shall be collected from the inlet ductwork to the System. Exhaust samples shall be taken from the System exhaust stack.

c. In addition to monitoring and recording inlet and exhaust H_2S concentrations, the following data shall be recorded at 2-hour intervals over the two-day performance testing duration:

1) Air flow rate.
2) ORP and pH in each stage.
3) Pressure drop across scrubber.
4) Chlorine residual in each sump.

d. Should the System performance not meet the requirements outlined in Part 1.02, the System shall have failed the performance test. The OC Supplier shall make any additions or modifications to the System as may be necessary, at no additional cost to the City, and the performance tests for that System shall be repeated in their entirety.

E. OC Supplier’s representative witnessing the field tests is to furnish the City, through the Engineer, a written report certifying that the System:

1. Has been properly installed and accurately aligned.

2. Is free from any undue stress imposed by connecting piping and/or anchor bolts.

3. Has been operating under a range of load conditions and that the System operates satisfactorily.

4. The Contractor has accurately recorded the data obtained during the field test.

F. Any failure or malfunction of equipment or controls shall cause the test to be invalidated, and the test shall be repeated.

3.05 CHEMICAL FILLS

A. The Contractor shall furnish sodium hypochlorite and sodium hydroxide in sufficient quantities as necessary to successfully complete startup.

B. Following completion of startup, the Contractor shall supply sodium hypochlorite and sodium hydroxide to fill all bulk storage tanks.

- END OF SECTION -

SECTION 13121 – PRE-ENGINEERED METAL BUILDING SYSTEM

PART 1 - GENERAL

1.01 THE REQUIREMENT

A. The CONTRACTOR shall furnish, fabricate and install pre-engineered metal building systems where shown on the drawings, complete in accordance with the Drawings and the requirements of the Contract Documents.

B. The manufacturer shall design and fabricate the metal structural system including primary and secondary member connections, purlins, girts, roof and wall panels, bracings, fasteners, connections, sealants, gutters, downspouts, frame openings for louvers, doors and windows, anchor bolts, and all other parts required for a complete installation.

C. All steel shall be field painted in accordance with the requirements of section 09900, “Painting”.

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 05010 Metal Materials

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. Florida Building Code

2. AISC "Code of Standard Practice for Steel Buildings and Bridges."

3. AISC "Specifications for the Design, Fabrication, and Erection of Structural Steel for Buildings" and including the "Commentary of the AISC Specification."

4. AISC "Specifications for Structural Joints Using ASTM A 325 or A 490 Bolts" approved by the Research Council of Riveted and Bolted Structural Joints of the Engineering Foundation.

5. AWS Structural Welding Code AWS DI.1 and "Standard Qualification Procedure."

6. Metal Building Manufacturer's Association (MBMA) "Metal Building Systems Manual."

7. ALSC MB Category Metal Building Systems Certification.

8. All the codes and standards listed in the Section entitled "Cast-In-Place Concrete."

1.04 DESIGN CRITERIA

A. Building Description:

1. The building overall dimensions shall be as shown on the Drawings. Column locations shall be as shown on the Drawings unless otherwise accepted by the ENGINEER. The roof shall have a slope as indicated on the drawings.

B. Design Loads:

1. The metal building system shall be designed for the loads indicated in the Specifications and Drawings.

2. Dead Load shall be the total weight of the metal building including all attachments to the structure. Loads imposed on the building by piping, ductwork and other equipment shall be considered as dead load on the structure. All piping shall be assumed to be running full of sludge for design purposes

3. Roof live load shall be 20 PSF, or greater as required by the Florida Building Code, on the horizontal projection of the roof.

4. Wind load pressure shall be based on an ultimate design wind velocity of 180 MPH -3 second gust, Exposure C, corresponding to Risk Category III buildings and structures. Wind loads shall be calculated based upon the specified methods in the Florida Building Code and ASCE 7-16.

5. Equipment loads shall be as specified on the drawings.

6. Each member shall be designed to withstand the stresses resulting from the combinations of loads that produces the maximum percentage of actual to allowable stress in that member. Allowable stresses for combinations including wind may be increased by 33 1/2%, provided the member thus required is not less than that required for the combination of dead and live load.

7. Load combinations shall be as specified in ASCE 7-16.

1.05 SUBMITTALS

A. The CONTRACTOR shall submit shop drawings including manufacturer's erection drawings and design calculations of the metal building, in accordance with the Section entitled "Submittals." All shop drawings and design calculations shall carry the seal and signature of a Professional Engineer registered in the State of Florida.

B. Shop drawings shall conform to AISC recommendations and Specifications and shall show all openings, etc. required for other Work. Drawings shall include complete details showing all member and their connections, anchor bolt layouts, schedules for fabrication procedures, and diagrams showing the sequence of erection.

C. Manufacturer’s product information, specifications, and installation instruction for building components and accessories.

D. Welder certifications shall be submitted for shop and field welders in triplicate, directly to the ENGINEER from a recognized testing laboratory, with copies to the CONTRACTOR and others as required.

E. Certification for grade and location of manufacture of all fasteners shall be submitted.

F. A color selection chart from the manufacturer shall be submitted indicating finish color on all exterior wall panels, trims and roof drainage accessories.

G. The metal building manufacturer shall furnish design calculations that demonstrate that the structural framing, roof and wall panels and its connections meet the design loads requirements.

H. The CONTRACTOR shall have unit responsibility for coordinating all equipment, piping and ductwork loads, piping and electrical work associated with the building on the design. The CONTRACTOR shall coordinate such data as is necessary.

I. Letter stating erector’s qualifications as described in Article 1.06 below.

J. Miami-Dade Product Approvals or Florida Product Approvals for all building components and cladding.

1.06 QUALITY ASSURANCE

A. The building manufacturer shall have an ongoing quality control program encompassing materials, fabrication and delivery. The manufacturer shall have been engaged in the design of this type of building for at least five years.

B. Shop inspection may be required by the CITY at the CITY's expense. The CONTRACTOR shall give ample notice to the ENGINEER prior to the beginning of any fabrication Work so that inspection may be provided. The CONTRACTOR shall furnish all facilities for the inspection of materials and workmanship in the shop and inspectors shall be allowed free access to the necessary parts of the work. Inspectors shall have the authority to reject any materials or Work which does not meet the requirements of these Specifications. Inspection at the shop is intended as a means of facilitating the Work and avoiding errors, but it is expressly understood that it will in no way relieve the CONTRACTOR from its responsibility for furnishing proper materials or workmanship under this Specification.

C. The CITY may engage inspectors to inspect welded connections and to perform tests and prepare test reports.

1. Ten percent of all butt and bevel welds which extend continuously for 24 inches or less may be completely tested in accordance with AWS DI.1, Part B, Radiographic Testing of Welds, Chapter 6. All butt and bevel welds which extend continuously for more than 24 inches may be spot tested at intervals not exceeding 36 inches.

2. Welds that are required by the ENGINEER to be corrected shall be corrected or redone and retested as instructed, at the CONTRACTOR's expense by an acceptable independent testing lab and to the satisfaction of the ENGINEER.

D. CONTRACTOR shall furnish the name of erector proposed to use for this work including necessary evidence and/or experience records to ascertain their qualifications in the erection of metal buildings.

1.07 WARRANTIES

A. All work performed on this project shall be free from defective materials and workmanship for a period of five years from date of acceptance by the CITY. The building manufacturer shall provide a warranty on defective materials for a period of five years from acceptance.

B. The finish of the wall panels and roof panels shall be warranted by the building manufacturer for 10 years against blistering, peeling, cracking, flaking, chalking and chipping. Color change shall not exceed 5 NBS units as per ASTM D 2244. Caulking shall not be less than a rating of 8 as per ASTM D 659.

1.08 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Structural members shall be loaded in such a manner that they may be transported and unloaded without being over-stressed, deformed, or otherwise damaged.

B. Structural steel members and packaged materials shall be protected from corrosion and deterioration. Material shall be stored in a dry area and shall not be placed in direct contact with the ground. Materials shall not be placed on the structure in a manner that might cause distortion or damage to the members or the supporting structures. Damaged materials or structures shall be repaired or replaced as specified by the ENGINEER.

1.09 MANUFACTURERS AND BUILDERS

A. The pre-engineered metal building shall be as manufactured by United Structures of America, Houston, Texas, Butler Manufacturing, Varco Pruden Metal Building Systems, CECO Building Systems, or approved equal. The metal building shall be installed by a builder approved by the manufacturer.

1.10 COORDINATION

A. The CONTRACTOR shall properly coordinate building design and installation with other trades. Doors, roll-up doors, and louvers specified herein are not manufactured by the

building manufacturer and will have to be provided and coordinated with the building installation by the CONTRACTOR.

PART 2 - PRODUCTS

2.01 STRUCTURAL MATERIALS

A. All structural and covering materials shall be new and meet physical design requirements. All structural steel shall be prime painted prior to shipping. All fabrication workmanship shall meet the fabrication tolerance as published by the MBMA.

B. Cold-formed sections shall be manufactured by precision roll or brake forming. All dimensions shall be true, and the formed members shall be free of fluting, bucking or waving. Cold formed sections shall conform to the requirements of Specification Section 05010, Metal Materials.

C. All structural shapes shall be made of hot-rolled steel sheets conforming to the requirements of specification Section 05010, "Metal Materials" plates and strip of built-up section shall have a minimum yield point of 50,000 psi.

D. All 14, 15 and 16 gage cold-formed sections shall have a minimum yield point of 50,000 psi.

F. All galvanized sheets and strips for structural framing shall conform to ASTM A 446, Grade "A."

2.02 STRUCTURAL FRAMING

A. Primary Frames

1. Primary framing shall be of rigid connections.

2. Roof beams and columns shall be welded up plate sections, tapered or uniform depth with solid web, complete for bolted field assembly.

3. All cap plates, compression plates, stiffener plates, and base plates shall be factory welded into place, and have the bolt connection holes shop fabricated.

4. Columns and roof beams shall be shop fabricated, complete with holes in flanges for the attachment of secondary structural members except for field work as noted on the manufacturer's erection drawings.

B. Endwall Framing

1. Endwall structural framing shall be achieved by primary framing specified herein. Channel framing will not be acceptable.

2.03 SECONDARY STRUCTURAL MEMBERS

A. Purlins, Girts and Eave Struts:

1. All steel purlins and girts, shall be “Z” sections either cold formed, hot-rolled, or built-up steel sections having a minimum yield point of 50,000 psi. Outer flanges of all girts and purlins shall contain factory-punched holes for panel connections and for connection to primary frames.

B. Bracing

1. Diagonal bracing shall be provided with rods. Cable bracing will not be acceptable. Where indicated on the drawings that portal frames are required, vertical diagonal bracing is not allowed and lateral load resistance in direction perpendicular to main frames shall be achieved with a bidirectional moment-resisting frame. Horizontal diagonal bracing shall be provided with rods. Cable type bracing will not be acceptable.

2. All diagonal bracing and sag rods, when required, shall be hot-rolled having a minimum yield point of 50,000 psi. Flange braces, purlin braces and sag rods, when required, shall be cold formed having a minimum yield point of 50,000 psi.

2.04 BOLTED AND WELDED CONNECTIONS

A. All field connections in main framing members shall be bolted, using high strength bolts, in accordance with the requirements of ASTM A 325. High strength bolts shall be hot dip galvanized. Field connections between main and secondary framing members shall be made with either ASTM A 325 or A 307 bolts. All ASTM A 307 bolts shall be hip dip galvanized. All bolted connections shall contain at least two bolts minimum.

B. The laying surfaces of all bolted connections shall be smooth and free from burrs or distortions.

C. All shop connections shall be welded in accordance with the American Welding Society "Structural Welding Code." Welding of steel sections shall be submerged arc or gas shielded arc process.

D. Anchorage: The building anchor bolts shall be designed to resist the column reactions. The diameter and layout of the bolts shall be as specified by the building manufacturer. The builder shall provide anchor bolts, anchor bolt setting plans and other information required by the CONTRACTOR to set the anchor bolts. Anchor bolts shall be threaded rods conforming to ASTM F 593 Type 316 stainless steel.

2.05 ROOF PANELING

A. The roof panels and connections shall have an Underwriters Laboratories uplift rating of

Class 90 and shall be capable of resisting wind, dead, and live load forces as specified in the Article 1.04 entitled "Design Criteria".

B. Roof panels shall be of the ribbed type. The panel material shall be min. 24 gage steel (or greater to resist specified loads) with a minimum yield of 42,000 psi. Finish shall be Zinc-Aluminum Alloy coated per ASTM A 792. Roof panels shall be painted with a fluoropolymer coating containing 70 percent “Kynar 500”. Roof system shall be PBR ribbed by United Structures of America, Butlerib II Roof System by Butler Manufacturing Company, or approved equal.

C. Panels shall be designed in accordance with AISC "Specifications for the Design of Light Gage Cold Formed Steel Structural Members" and in accordance with the specified loadings.

D. Roof panels shall be factory punched at panel ends to match pre-punched holes in structural members. Eave and splice panels shall have slots to provide for expansion and contraction.

E. The panels shall be precision roll-framed to provide width coverage of 2-feet minimum.

F. Ridge panels when required shall be one piece, factory covered to match the roof slope.

2.06 ROOF AND WALL FASTENERS

A. Roof and wall panels shall be attached to secondary framing members by No. 410 stainless steel self-drilling screws with weather seal washers or galvanized steel self-drilling screws compatible with the roof and wall panel finish.

B. All fastener locations shall be as indicated on the manufacturer's erection drawings.

2.07 GUTTERS AND DOWNSPOUTS

A. Manufacturers standard eave gutters and downspouts shall be fabricated from 26 gauge steel with a baked on paint finish to match wall panels.

2.08 SEALANTS AND CLOSURES

A. Polyethylene closed cell closure strips shall be used wherever necessary to insure weather tightness.

B. Roof panel endlaps shall be sealed with a gray elastic compound that equals or exceeds military Specification MIL-C-18969, Type II, Class B.

2.09 ACCESSORIES

A. Accessories supplied by the manufacturer shall include, but not be limited to, the following:

1. Overhang of similar construction as the roof system with soffit panels matching the exterior wall finishes.

2. Sheet metal roof gutters, down spouts and miscellaneous edge flashings with finishes matching the walls.

3. Louvers and gravity dampers shall be provided as specified.

4. Provide manufacturers standard skylights on roof of building as shown on the Drawings.

2.10 FINISHES

A. Color selections will be made by the CITY from the manufacturer's standard colors.

B. Finishes shall be as follows:

1. Structural framing and structural bolts: At the factory, structural framing shall receive one shop coat of primer. At the field, structural framing shall be prepared in accordance with SSPC-SP6 to remove shop primer and provide adequate surface to field paint in accordance with specification Section 09900, "Painting". Structural bolts shall be hot dip galvanized.

2. Wall panels: Zinc aluminum alloy coatings, both sides**,** and painted with a fluoropolymer coating containing 70 percent "Kynar 500".

3. Trims, eaves, gutters, down spouts and accessories: Same type of finish as wall panels. Color will be selected during shop drawing review.

4. Roof panels: Zinc aluminum alloy coatings, both sides.

PART 3 -- EXECUTION

3.01 MEASUREMENT

A. The CONTRACTOR shall verify all dimensions and shall make any field measurements necessary and shall be fully responsible for accuracy and layout of Work. The CONTRACTOR shall review the Drawings and any discrepancies shall be reported to the ENGINEER for clarification prior to starting fabrication.

3.02 FABRICATION

A. Structural steel shall be fabricated in accordance with the Drawings, AISC Specifications, and as indicated on the final reviewed shop drawings.

B. Materials shall be properly marked and match-marked for field assembly.

C. Where finishing is required, assembly shall be completed including bolting and welding of units, before start of finishing operations.

3.03 CONNECTIONS

A. Shop connections shall be welded or bolted as shown. Field connections shall be bolted except where welded connections are specified. All connections, unless shown otherwise shall develop full strength of members joined and shall conform to AISC standard connections.

3.04 WELDED CONSTRUCTION

A. The CONTRACTOR shall comply with the current AWS D1.1 Code for procedures, appearance, and quality of welds and welders, and methods used in correcting welding work.

B. Unless otherwise shown, all butt and bevel welds shall be complete penetration.

3.05 OPENINGS FOR OTHER WORK

A. Openings shall be provided per AISC Specifications, or as indicated for securing other Work to structural steel framing and for the passage of other Work through steel framing members. Threaded nuts shall be welded to framing, and other specialty items, as shown, to receive the Work. Torch cut holes will not be permitted.

3.06 ERECTION AND INSTALLATION

A. The erection of the building metal frame system shall be performed in accordance with the building manufacturer's erections drawings and instructions. Erection shall be performed by a qualified erector using proper tools and equipment. The building manufacturer shall supply as a minimum a qualified construction advisor during the erection and installation period.

B. Any field modification shall not be made to structural members except as authorized and specified by the building manufacturer.

3.07 SETTING BASES AND BEARING PLATES

A. Prior to the placement of non-shrink grout beneath base and bearing plates, the bottom surface of the plates shall be cleaned of all foreign materials, and concrete and masonry bearing surface shall also be cleaned of all foreign materials and roughened to improve bonding.

B. Loose and attached baseplates and bearing for structural members shall be set on wedges, leveling nuts, or other adjustable devices.

C. Anchor bolts shall be tightened after the supported members have been positioned and plumbed and the non-shrink grout had attained its specified strength.

D. Baseplates shall be grouted with non-shrink grout to assure full uniform bearing. Grouting shall be done prior to placing loads on the structure.

3.08 FIELD ASSEMBLY

A. Structural frames shall be set accurately to the lines and elevations indicated. The various members shall be aligned and adjusted to form a part of a complete frame or structure before being permanently fastened. Bearing surfaces and other surfaces which will be in permanent contact shall be cleaned before assembly. Necessary adjustments to compensate for discrepancies in elevations and alignments shall be performed, as necessary.

B. Individual members of the structure shall be leveled and plumbed within specified AISC tolerances. The CONTRACTOR shall provide and install all temporary bracing required until structure is complete.

3.09 MISFITS AT BOLTED CONNECTIONS

A. Where misfits in erection bolting are encountered, the ENGINEER shall be immediately notified. The CONTRACTOR shall submit a method to remedy the misfit for review by the ENGINEER. The ENGINEER will determine whether the remedy is acceptable or if the member shall be refabricated.

B. Incorrectly sized or misaligned holes in members shall not be enlarged by burning or by the use of drift pins. The CONTRACTOR shall notify the ENGINEER immediately, and shall submit a proposed method of remedy for review by the ENGINEER. The ENGINEER will determine whether the remedy is acceptable.

3.10 MISFITS AT ANCHOR BOLTS

A. Where misalignment between anchor bolts and bolt holes in steel members are encountered, the ENGINEER shall be immediately notified. The CONTRACTOR shall submit a method to remedy the misalignment for review by the ENGINEER. The ENGINEER will determine whether the remedy is acceptable. The CONTRACTOR shall abide by the ENGINEER's decision.

3.11 GAS CUTTING

A. Gas cutting torches shall not be used in the field for correcting fabrication errors in the structural framing, except when acceptable to the ENGINEER. Gas-cut sections shall be finished equal to a sheared appearance.

3.12 FIELD PAINTING

A. All structural steel shall be field painted after erection per Section 09900.

- END OF SECTION -

CITY OF HOLLYWOOD

FLORIDA

CONTRACT DOCUMENTS

SOUTHERN REGIONAL WASTEWATER TREATMENT PLANT

OXYGENATION FLOW DISTRIBUTION BOX ODOR CONTROL SYSTEM REPLACEMENT

CITY PROJECT BID NO. IFB-051-23-JJ

BID SET

VOLUME 1 OF 2

SEPTEMBER 2022

Hazen

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

Engineers Project No. 4321-082

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CITY OF HOLLYWOOD

SOUTHERN REGIONAL WASTEWATER TREATMENT PLANT

OFDB ODOR CONTROL SYSTEM REPLACEMENT

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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. Wherever the Contract Documents address a third party, i.e. subcontractor, manufacturer, etc. it is to be considered as the CONTRACTOR through the third party.

C. 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 project includes the furnishing of all labor, materials, equipment, services and incidentals for the construction of new odor control facilities and air handling system at the OFDB at the SRWWTP. The project will include the demolition and removal of the existing facilities and the construction of new facilities as identified in the Contract Documents and briefly summarized below:

B. The work to be performed includes site, civil, sitework, mechanical, structural, architectural, electrical, instrumentation and all related work associated with the following:

- Oxygenation System Flow Distribution Box (OFDB) Demolition Phase: This work consists of the demolition and removal of the existing odor control system servicing the ODFB including but not limited to, scrubber system, fan, ductwork and supports, recirculation pumps, chemical storage tanks, chemical feed pumps, chemical piping and valves, instrument and controls, electrical conduit and wiring, containment wall, concrete equipment pad, concrete slab, drain piping, water softener system, eyewash, as identified in the Contract Documents. The project also includes the demolition and removal of the instrument air handling system servicing the oxygenation trains including, air piping and valves, air compressors, air dryer, air receiver, instrumentation and controls, electrical conduit and wiring, concrete equipment pad, concrete slab, as identified in the Contract Documents.

- Oxygenation System Flow Distribution Box (OFDB) Construction Phase: This work consists of the construction of a new odor control system to service the OFDB including but not limited to, scrubber system, fan, ductwork and supports, recirculation pumps, chemical storage tanks, chemical feed pumps, chemical piping and valves, instrument and controls, electrical conduit and wiring, concrete slab and containment area, concrete equipment pads, fill station, metal canopy, drain piping, water softener system and eyewash. The project also includes the construction of the new instrument air handling system to service the oxygenation trains including, air piping and valves, air compressors, air dryer, air receiver, instrumentation and controls, electrical conduit and wiring, concrete equipment pad, concrete slab, as identified in the Contract Documents.

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.

C. All work shall be in compliance with all applicable federal, state and local laws and regulations, including those for materials that contain lead. All work shall meet OSHA requirements.

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, OFDB Odor Control System 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 benchmarks, 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 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 – Submittals, unless otherwise specified. A representative of the CONTRACTOR shall witness all field measurements.

1.03 PAYMENT ITEMS

A. 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 Items No. 2 and No. 3.

2. Item No. 2 – All Work Associated with the Demolition Phase: Included in this item is payment for all labor, equipment, and material for all Work necessary and required for Demolition Phase activities, including but not limited to, all general, civil, mechanical, electrical, structural, instrumentation, controls work elements, as detailed in the Contract Documents.

3. Item No. 3 – All Work Associated with the Oxygenation System Flow Distribution Box (OFDB): Payment for all labor, equipment, and materials for all work necessary and required for the complete furnishing, delivery and installation of odor control facilities and instrument air handling system as required in the Contract Documents. This item includes, but is not limited to, all general, civil, mechanical, structural, architectural, electrical, instrumentation and control, equipment testing, startup services and construction sequencing required for a complete and operable system.

4. Item No. 4 – 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 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, 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. The cost of any required inspection or any required test which CONTRACTOR fails shall be paid for by CONTRACTOR.

5. Item No. 5 – 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.

6. Item No. 6 – 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. The CITY reserves the right to award any, all, or none of the money associated with this allowance.

7. Item No. 7 – 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.

8. Item No. 8 – Demobilization: Payment for completing all other 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 Bid Item Nos. 2 and 3.

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 monthly 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 monthly 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:

Copies to ENGINEER	Type of Submittal
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

[1]One USB flash drive containing the electronic source file shall be included
[2]Unless otherwise required in the specific Section where requested.
[3]One 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, Temporary Enviornmental Controls.

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, not withstanding 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 – Basis of Payment, 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 six (6) 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 (6 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

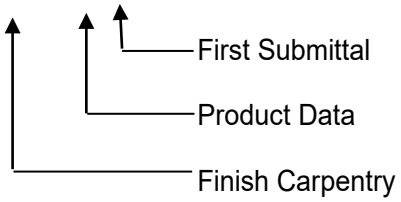
07 O&M

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:

Package	**Submittal**	**Description**
03300	03300-01-1.1	Concrete Admixture A, First Submittal
06400	06400-01-1.2	Re-submittal



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, CONTRACTOR, 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. 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 digital videos covering the respective, affected construction area by the ENGINEER. The ENGINEER shall have the authority to reject all or any portion of the digital video 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. 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 videos shall be prepared by a responsible commercial firm known to be skilled and regularly engaged in the business of preconstruction color audio-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 DVD 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 video 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 their 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. Location
2. Name/number of Structure
3. Photo Number
4. Date picture was taken
5. Description
6. Name of photographer
7. CITY's witness

B. Digital images of each photograph shall be submitted electronically to the ENGINEER with the CONTRACTOR's monthly estimate.

PART 2 -- PRODUCTS (Not Used)

PART 3 -- EXECUTION (Not Used)

- END OF SECTION –

SECTION 01400 - TESTING AND INSPECTION

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. All testing and inspection will be in accordance with Article 12 of the Public Utilities General Condtions.

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 inspectons 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. 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, "Submittals".

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 Public Utilities 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, "Submittals", 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, 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, etc.

B. Demolition 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, “Project Closeout”.

3. Final acceptance of project.

4. Commence warranty period.

1.08 DETAILED SEQUENCE OF CONSTRUCTION AND OPERATIONAL CONSTRAINTS

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 may be required. The sequence of construction is a precedence requirement and does not attempt to schedule the CONTRACTOR's Work.

A. Instrument Air Piping Modifications

1. General Requirements:

a. The CONTRACTOR shall notify the CITY in writing ten days in advance of any work done to the Instrument Air Piping.

b. The instrument air pipes are limited to one shut down of one week in duration to perform the required work.

2. Detailed Sequence of Construction for Work for Instrument Air Piping Modifications

a. Complete installation, testing and acceptance of new 1” instrument air pipes.

b. Coordinate with CITY to shut down existing equipment to facilitate tie-in of new 1” instrument air pipes.

c. City shall place new instrument air pipe to existing facilities back into service. New connection to new air handling system will be completed upon installation of new equipment.

d. Complete all demolition work on all instrument air pipes.

B. Oxygenation System Flow Distribution Box (OFDB) Modifications:

1. Demolition Phase:

a. Initiate and complete all demolition activities within the OFDB area as shown on the Contract Documents. The proposed demolition activities include, but are not limited to, the following:

- Demolition and removal of the existing odor control system servicing the ODFB including but not limited to, scrubber system, fan, ductwork and supports, recirculation pumps, chemical storage tanks, chemical feed pumps, chemical piping and valves, instrument and controls, electrical conduit and wiring, containment wall, concrete equipment pad, concrete slab, drain piping, water softener system and eyewash.

- Demolition and removal of the instrument air handling system servicing the oxygenation trains including, air piping and valves, air compressors, air dryer, air receiver, instrumentation and controls, electrical conduit and wiring, concrete equipment pad, and concrete slab.

2. Construction Phase:

a. CONTRACTOR shall initiate and complete all construction activities. Construction includes structural, civil, mechanical, electrical, instrumentation and controls, required for complete and operable system. The proposed facilities to be constructed include, but are not limited to, the following:

- New odor control system to service the OFDB including scrubber system, fan, ductwork and supports, recirculation pumps, chemical storage tanks, chemical feed pumps, chemical piping and valves, instrument and controls, electrical conduit and wiring, concrete slab and containment area, concrete equipment pads, fill station, metal canopy, drain piping, water softener system and eyewash.

- New instrument air handling system to service the oxygenation trains including, air piping and valves, air compressors, air dryer, air receiver, instrumentation and controls, electrical conduit and wiring, concrete equipment pad, concrete slab.

b. CONTRACTOR shall successfully complete all piping testing, equipment leak testing, hydrostatic testing, and manual and automatic control strategies for the new odor control system and new instrument air handling system.

c. Energize and successfully complete all equipment testing, startup and performance testing requirements and specified manufacturer training of CITY personnel for the facilities.

d. A successful performance of five (5) consecutive days is required for the new odor control facilities prior to the issuance of a certificate of substantial completion.

1.09 WORK PLAN (Not Used)

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, as necessary, 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 Public Utilities 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 the Public Utilities 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	46th 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 planed. 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 Public Utilities General Conditions, Supplementary General 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. The CONTRACTOR shall allow sufficient time in its construction schedule to complete testing, trouble shooting and start-up activities.

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.

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 DVD recording of all training sessions (as selected by the CITY). Two labeled copies of each training session tape 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:

_____	_____
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- 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 01300 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 water-

tightness 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. CONTRACTOR shall coordinate with CITY regarding items to be salvaged.

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: 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, granual 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. Benchmarks, 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 $ft \cdot lbf/ft^3$ (600 $kN \cdot m/m^3$)).
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 $ft \cdot lbf/ft^3$ (2,700 $kN \cdot m/m^3$)).
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 Section 01300 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:

Sieve Size	Percent Finer by Weight
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:

Sieve Size	Percent Finer by Weight
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 Section 02510, “Asphaltic Concrete Pavement”, and Section 02526, “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 and 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 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 degration 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 Section 02510 entitled “Asphaltic Concrete Pavement.”

C. Restore all concrete pavement, curbs, and sidewalks disturbed by the trenching operations in accordance with Section 02526 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 entitled, “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 - Quality Control. 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.

1.06 JOB CONDITIONS

A. The CONTRACTOR shall satisfy itself as to the character and amount of different soil materials, groundwater and the subsurface conditions to be encountered in the Work to be performed. Information and data, when furnished, are for the CONTRACTOR's general information. However, it is expressly understood that any interpretation or conclusion drawn therefrom is totally the responsibility of the CONTRACTOR. ENGINEER and CITY assumes no liability for the accurateness of the data reported.

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. Sheeting may be removed (unless specifically noted to be left in place) provided its removal will not jeopardize existing or new pipes or structures. Any sheeting left in place shall be cut-off 2 feet below finish grade, or as directed. The CONTRACTOR will not receive extra compensation for sheeting 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.

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 6 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 hand compactor that will not damage the surrounding structures. 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 compactor. Compaction must achieve a minimum density of 95 percent of soils modified Proctor Density as tested for the depth of 2 ft. below foundation level.

1. Compact the exposed stripped and excavated surface area by means of an approved compacting device 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 2 ft 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 compaction operation and replace with suitable fill material.

2. Heavy vibratory equipment shall not be used for this project.

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.

C. Foundation Preparation (Filling, Backfilling and Excavation):

1. Buildings: Compact the stripped area to minimum of 95 percent of the Modified Proctor density. Provide structural fill if necessary in 6” maximum lifts. Compaction of the surface shall be a minimum of 95 percent the Modified Proctor density from the top to 2 ft below the surface.

2. 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.

3. 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 12-inches below the surface.

4. Form monolithic slab beams by excavating from the compacted fill material to grades and lines indicated on the Drawings.

5. 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.

6. 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.

7. Test compaction of all structural fill by a testing lab as specified.

8. 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 manufacturer's 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, benchmarks, 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. Section 02510 – Asphaltic Concrete Pavement.

B. Section 02210 – Site Grading

C. Section 2526 – Concrete Pavement, Curb, and Sidewalks

1.03 SUBMITTALS

A. The CONTRACTOR shall submit submittals for review in accordance with 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. If any new tree, plant or shrub dies within the guarantee period, the CONTRACTOR shall be responsible for replacement in kind. If 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 pints 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 Section 01300 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 ensure 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 recompacting, at no additional cost to the CITY.

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 Section 01300 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 then the other or the entire joint is higher or lower then 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 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. If 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 SUBMITTALS

A. Submit the following in accordance with Section 01300, Submittals.

1. Manufacturer's data on proposed form release agent

2. Manufacturer's data on proposed formwork system form ties

1.06 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.

C. Concrete formwork shall be in accordance with ACI 301, ACI 318, and ACI 347.

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. Wood 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 FORM DESIGN

A. Forms and falsework shall be designed for total dead load, plus all construction live load as outlined in ACI 347. Design and engineering of formwork and safety considerations during construction shall be the responsibility of the Contractor.

B. Forms shall be of sufficient strength and rigidity to maintain their position and shape under the loads and operations incident to placing and vibrating the concrete. The maximum deflection of facing materials reflected in concrete surfaces exposed to view shall be 1/240 of the span between structural members.

C. All forms shall be designed for predetermined placing rates per hour, considering expected air temperatures and setting rates.

3.02 CONSTRUCTION

A. The type, size, quality, and strength of all materials from which forms are made shall be subject to the approval of the Engineer. No falsework or forms shall be used which are not

clean and suitable. Deformed, broken or defective falsework and forms shall be removed from the work.

B. Forms shall be smooth and free from surface irregularities. Suitable and effective means shall be provided on all forms for holding adjacent edges and ends of panels and sections tightly together and in accurate alignment so as to prevent the formation of ridges, fins, offsets, or similar surface defects in the finished concrete. Joints between the forms shall be sealed to eliminate any irregularities. The arrangement of the facing material shall be orderly and symmetrical, with the number of seams kept to a practical minimum.

C. Forms shall be true to line and grade, and shall be sufficiently rigid to prevent displacement and sagging between supports. Curved forms shall be used for curved and circular structures. Straight panels joined at angles will not be acceptable for forming curved structures. Forms shall be properly braced or tied together to maintain their position and shape under a load of freshly placed concrete. Facing material shall be supported with studs or other backing which shall prevent both visible deflection marks in the concrete and deflections beyond the tolerances specified.

D. Forms shall be mortar tight 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.

E. All vertical surfaces of concrete members shall be formed, and side forms shall be provided for all footings, slab edges and grade beams, except where placement of the concrete against the ground is called for on the Drawings. Not less than 1-inch of concrete shall be added to the thickness of the concrete member as shown where concrete is permitted to be placed against trimmed ground in lieu of forms. Such permission will be granted only for members of comparatively limited height and where the character of the ground is such that it can be trimmed to the required lines and will stand securely without caving or sloughing until the concrete has been placed

F. All forms shall be constructed in such a manner that they can be removed without hammering or prying against the concrete. Wood forms shall be constructed for wall openings to facilitate loosening and to counteract swelling of the forms.

G. Adequate clean out holes shall be provided at the bottom of each lift of forms. Temporary openings shall be provided at the base of column forms and wall forms and at other points to facilitate cleaning and observation immediately before the concrete is deposited. The size, number and location of such clean outs shall be as acceptable to the Engineer.

H. Construction joints shall not be permitted at locations other than those shown or specified, except as may be acceptable to the Engineer. When a second lift is placed on hardened concrete, special precautions shall be taken in the way of the number, location and tightening of ties at the top of the old lift and bottom of the new to prevent any unsatisfactory effect whatsoever on the concrete. For flush surfaces at construction joints exposed to view, the contact surface of the form sheathing over the hardened concrete in the previous placement shall be lapped by not more than 1 inch. Forms shall be held against hardened

concrete to prevent offset or loss of mortar at construction joints and to maintain a true surface.

I. The formwork shall be cambered to compensate for anticipated deflections in the formwork due to the weight and pressure of the fresh concrete and due to construction loads. Set forms and intermediate screed strips for slabs accurately to produce the designated elevations and contours of the finished surface. Ensure that edge forms and screed strips are sufficiently strong to support vibrating screeds or roller pipe screeds if the nature of the finish specified requires the use of such equipment. When formwork is cambered, set screeds to a like camber to maintain the proper concrete thickness.

J. Positive means of adjustment (wedges or jacks) for shores and struts shall be provided and all settlement shall be taken up during concrete placing operation. Shores and struts shall be securely braced against lateral deflections. Wedges shall be fastened firmly in place after final adjustment of forms prior to concrete placement. Formwork shall be anchored to shores or other supporting surfaces or members to prevent upward or lateral movement of any part of the formwork system during concrete placement. If adequate foundation for shores cannot be secured, trussed supports shall be provided.

K. Runways shall be provided for moving equipment with struts or legs. Runways shall be supported directly on the formwork or structural member without resting on the reinforcing steel.

3.03 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.

3.04 EARTH FORMS

A. All vertical surfaces of concrete members shall be formed, except where placement of the concrete against the ground is called for on the Drawings. Not less than 1 inch of concrete shall be added to the thickness of the concrete member as shown where concrete is permitted to be placed against trimmed ground in lieu of forms. Such permission will be granted only for members of comparatively limited height and where the character of the ground is such that it can be trimmed to the required lines and will stand securely without caving or sloughing until the concrete has been placed.

3.05 FOOTINGS, SLAB EDGES AND GRADE BEAMS

A. Provide wood side forms for all footings, slab edges and grade beams.

3.06 FORM ACCESSORIES

A. Suitable moldings shall be placed to bevel or round all exposed corners and edges of beams, columns, walls, slabs, and equipment pads. Chamfers shall be 3/4 inch unless otherwise noted.

B. Form ties shall be so constructed that the ends, or end fasteners, can be removed without causing appreciable spalling at the faces of the concrete. After ends, or end fasteners of form ties have been removed, the embedded portion of the ties shall terminate not less than 2 inches from the formed face of the concrete that is exposed to water or enclosed surfaces above the water surface, and not less than 1 inch from the formed face of all other concrete. Holes left by the removal of form tie cones shall be reamed with suitable toothed reamers so as to leave the surface of the holes clean and rough before being filled with mortar as specified in Section 03350 - Concrete Finishing. No form-tying device or part thereof, other than metal, shall be left embedded in the concrete. Ties shall not be removed in such manner as to leave a hole extending through the interior of the concrete member. The use of snap-ties which cause spalling of the concrete upon form stripping or tie removal will not be permitted. No snap ties shall be broken off until the concrete is at least three days old. If steel panel forms are used, rubber grommets shall be provided where the ties pass through the form in order to prevent loss of cement paste.

3.07 APPLICATION - FORM RELEASE AGENT

A. Apply form release agent on formwork in accordance with manufacturer's recommendations.

3.08 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.

3.09 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.

3.10 FORMWORK TOLERANCES

A. Formwork shall be constructed to ensure that finished concrete surfaces will be in accordance with the tolerances listed in ACI 347.

B. 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 ---------- ±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 ---------- ±1/8 in.
      Tread---------- ±1/4 in.

   b. In consecutive steps:
      Rise ---------- ±1/16 in.
      Tread---------- ±1/8 in.

**Tolerances apply to concrete dimensions only, not to positioning of vertical reinforcing steel, dowels, or embedded items.*

3.11 FORM REMOVAL

A. Forms shall not be disturbed until the concrete has attained sufficient strength. Shoring shall not be removed until the supported member has acquired sufficient strength to support its weight and the load upon it. Members subject to additional loads during construction shall be adequately shored to sustain all resulting stresses. Forms shall be removed in such manner as not to impair safety and serviceability of the structure. All concrete to be exposed by form removal shall have sufficient strength not to be damaged thereby.

B. 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.

C. 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 forms.....3 days
2. Wall forms .....3 days
3. Column forms.....3 days
4. Overhead beam and girder side forms.....3 days
5. Overhead beam bottoms and slab forms/shores .....14 days

D. When, in the opinion of the Engineer, conditions of the work or weather justify, forms may be required to remain in place for longer periods of time.

E. An accurate record shall be maintained by the Contractor of the dates of concrete placings and the exact location thereof and the dates of removal of forms. These records shall be available for inspection at all times at the site, and two copies shall be furnished the Engineer upon completion of the concrete work.

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 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 CITY 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. 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.

PART 3 – EXECUTION

3.01 FABRICATION

A. Reinforcing steel shall be accurately formed to the dimensions and shapes shown on the Drawings, and the fabricating details shall be prepared in accordance with ACI 315 and ACI 318, except as modified by the Drawings.

B. The CONTRACTOR shall fabricate reinforcing bars for structures in accordance with bending diagrams, placing lists, and placing Drawings.

C. No fabrication shall commence until approval of Shop Drawings has been obtained. All reinforcing bars shall be shop fabricated unless approved to be bent in the field. Reinforcing bars shall not be straightened or rebent in a manner that will injure the material. Heating of bars will not be permitted.

D. Welded wire fabric with longitudinal wire of W9.5 size or smaller shall be either furnished in flat sheets or in rolls with a core diameter of not less than 10 inches. Welded wire fabric with longitudinal wires larger than W9.5 size shall be furnished in flat sheets only.

3.02 DELIVERY, STORAGE AND HANDLING

A. All reinforcing shall be neatly bundled and tagged for placement when delivered to the job site. Bundles shall be properly identified for coordination with mill test reports.

B. Reinforcing steel shall be stored above ground on platforms or other supports and shall 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.

3.03 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.

3.04 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 plastic protected (CRSI Class 1) metal supports, spacers or metal hangers which are strong and rigid enough to prevent any displacement of the reinforcing steel. Where concrete is to be placed on the ground, supporting concrete blocks (or dobies) shall be used in sufficient numbers to support the reinforcing bars without settlement. In no case shall concrete block supports be continuous. .

B. The portions of all accessories in contact with the formwork shall be made of plastic or steel coated with a 1/8 inch minimum thickness of plastic which extends at least 1/2 inch from the concrete surface. Plastic shall be gray in color.

C. Tie wires shall be bent away from the forms 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.

3.05 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:

a.	ASTM C 920	Specification for Elastomeric Joint Sealants.
b.	ASTM D 624	Test Method for Rubber Property -- Tear Resistance.
c.	ASTM D 638	Test Method for Tensile Properties of Plastics.
d.	ASTM D 746	Test Method for Brittleness Temperature of Plastics and Elastomers by Impact.
e.	ASTM D 747	Test Method for Apparent Bending Modules of Plastics by Means of a Cantilever Beam.
f.	ASTM D 1752	Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
g.	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:

	Value	**ASTM Std.**
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
Accelerated Extraction (CRD-C572)		
Tensile Strength-min (psi)	1500	D 638, Type IV
Ultimate Elongation-min (percent)	300	D 638, Type IV
Effect of Alkalies (CRD-C572)		
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
Finish Waterstop		
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 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:

Physical Property	**Value**	**ASTM Std.**
Tensile Strength	1800 psi	D-412
Ultimate Elongation	450%	D-412

Physical Property	**Value**	**ASTM Std.**
100% Modulus	1000 psi	D-412
Shore A Hardness	85 units ± 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:

Physical Property	**Value**	**ASTM Std.**
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:

Fluid	**Physical Property**	**Value**
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%

Fluid	**Physical Property**	**Value**
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, process chemicals or other materials used in treatment process.

2. Class A2 Concrete: Normal weight structural concrete in all structures other than structures qualifying as environmental concrete structures as described above, and for all sidewalks and pavement. .

4. Class B Concrete: Normal weight structural concrete used for duct bank encasements, catch basins, fence and guard post embedment, concrete fill, and other areas where specifically noted on Contract Drawings.

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 ensure 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.

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 alkalies. The term "alkalies" referred to herein is defined as the sum of the percentage of sodium oxide and 0.658 times the percentage of potassium oxide (Na20 + 0.658 K20). 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, Pozzolith 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, Pozzolith 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, "Pozzolith 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 Advaflow 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; Concresive 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 content, per cubic yard	611 lbs.
Water-cementitious materials ratio, by weight	Maximum 0.42 Minimum 0.39
Slump range	3 inches to 4 inches with water reducing admixture
Coarse Aggregate	#57 per ASTM C33
Compressive strength at 28 days – F'c	4,500 psi
Air Content	3% ± 1%

2. Class A2 Concrete: Normal weight structural concrete in all structures other than structures qualifying as environmental concrete structures as described above, and for all sidewalks and pavement. .

Minimum cementitious materials content, per cubic yard	611 lbs.
Water-cementitious materials ratio, by weight	Maximum 0.45 Minimum 0.39
Slump range	3 inches maximum before addition of high range water reducing admixture 8 inches maximum after addition of high range water reducing admixture
Coarse Aggregate	#57 per ASTM C33
Compressive strength at 28 days – F'c	4,000 psi
Air Content	3% ± 1%

4. Class B Concrete: Normal weight structural concrete used for duct bank encasements, catch basins, fence and guard post embedment, concrete fill, and other areas where specifically noted on Contract Drawings. .

Minimum cementitious materials content, per cubic yard	500 lbs.
Water-cementitious materials ratio, by weight	Maximum 0.50 Minimum 0.39
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 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 CITY. 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 or hydrophobic 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 CITY.

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 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 CITY. 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. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.

1. CRD-C 621 – Corps of Engineers Specification for Non-shrink Grout.

2. ASTM C 33 – Standard Specification for Concrete Aggregates

3. ASTM C 109 – Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2 inch or 50 mm cube Specimens).

4. ASTM C 531 – Standard Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts and Monolithic Surfacings.

5. ASTM C 579 – Test Method for Compressive Strength of Chemical-Resistant Mortars and Monolithic Surfacings.

6. ASTM C 827 – Standard Test Method for Early Volume Change of Cementitious Mixtures.

7. ASTM C 1107 – Standard Specification for Packaged Dry, Hydraulic Cement Grout (Nonshrink).

1.04 SUBMITTALS

A. 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.

1.05 QUALITY ASSURANCE

A. Field Tests

1. Compression test specimens will be taken during construction from the first placement of each type of grout and at intervals thereafter as selected by the Engineer to ensure continued compliance with these Specifications. The specimens will be made by the Engineer or its representative.

a. Compression tests and fabrication of specimens for cement grout and non-shrink grout will be performed as specified in ASTM C 109 at intervals during construction as selected by the Engineer. A set of three specimens will be made for testing at seven days, 28 days, and any additional times as appropriate.

b. Compression tests and fabrication of specimens for epoxy grout will be performed as specified in ASTM C 579, Method B, at intervals during construction as selected by the Engineer. A set of three specimens will be made for testing at seven days and any other time as appropriate.

2. The cost of all laboratory tests on grout will be borne by the Owner, but the Contractor shall assist the Engineer in obtaining specimens for testing. The Contractor shall be charged for the cost of any additional tests and investigation on work performed which does not meet the specifications. The Contractor shall supply all materials necessary for fabricating the test specimens, at no additional cost to the Owner.

3. All grout, already placed, which fails to meet the requirements of these Specifications, is subject to removal and replacement at no additional cost to the Owner.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Cement Grout

1. Cement grout shall be composed of Portland Cement and sand in the proportion specified in the Contract Documents and the minimum amount of water necessary to obtain the desired consistency. If no proportion is indicated, cement grout shall consist of one-part Portland Cement to three parts sand. Water amount shall be as required to achieve desired consistency without compromising strength requirements. White Portland Cement shall be mixed with the Portland Cement as required to match color of adjacent concrete.

2. The minimum compressive strength at 28 days shall be 4000 psi.

3. For beds thicker than 1-1/2 inch and/or where free passage of grout will not be obstructed by coarse aggregate, 1-1/2 parts of coarse aggregate having a top size of 3/8 inch should be added. This stipulation does not apply for grout being swept in by

a mechanism. These applications shall use a plain cement grout without coarse aggregate regardless of bed thickness.

4. Sand shall conform to the requirements of ASTM C33.

B. Non-Shrink Grout

1. Non-shrink grout shall conform to CRD-C 621 and ASTM C 1107, Grade B or C when tested at a max. fluid consistency of 30 seconds per CDC 611/ASTM C939 at temperature extremes of 45°F and 90°F and an extended working time of 15 minutes. Grout shall have a min. 28-day strength of 7,000 psi. Non-shrink grout shall be, "Euco N-S" by the Euclid Chemical Company, "Sikagrout 212" by Sika Corporation, “Conspec 100 Non-Shrink Non-Metallic Grout” by Conspec, “MasterFlow 928” by Master Builders Solutions.

C. Epoxy Grout

1. Epoxy grout shall be "Sikadur 32 Hi-Mod" by Sika Corporation, "Duralcrete LV" by Tamms Industries, or "Euco #452 Series" by Euclid Chemical, “MasterEmaco ADH 1090 RS” by Master Builders Solutions.

2. Epoxy grout shall be modified as required for each application with aggregate per manufacturer's instructions.

D. Epoxy Base Plate Grout

1. Epoxy base plate grout shall be “Sikadur 42, Grout-Pak” by Sika Corporation, or “MasterFlow 648” by Master Builders Solutions.

2.02 CURING MATERIALS

A. Curing materials shall be as specified in Section 03370 – Concrete Curing for cement grout and as recommended by the manufacturer for prepackaged grouts

2.03 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.

2.04 MEASUREMENT OF INGREDIENTS

A. Prepackaged grouts shall have ingredients measured by means recommended by the manufacturer.

PART 3 – EXECUTION

3.01 GENERAL

A. The different types of grout shall be used for the applications stated below unless noted otherwise in the Contract Documents. Where grout is called for in the Contract Documents which does not fall under any of the applications stated below, non-shrink grout shall be used unless another type is specifically referenced. .

1. Cement grout shall be used for grout toppings and for patching of fresh concrete

2. Non-shrink grout shall be used for grouting beneath base plates of structural metal framing.

3. Epoxy grout shall be used for bonding new concrete to hardened concrete.

4. Epoxy base plate grout shall be used for precision seating of base plates including base plates for all equipment such as engines, mixers, pumps, vibratory and heavy impact machinery, etc.

B. New concrete surfaces to receive cement grout shall be as specified in Section 03350 – Concrete Finishes, and shall be cleaned of all dirt, grease, and oil-like films. Existing concrete surfaces shall likewise be cleaned of all similar contamination and debris, including chipping, or roughening the surface if a laitance or poor concrete is evident. The finish of the grout surface shall match that of the adjacent concrete. Curing and protection of cement grout shall be as specified in Section 03370 – Concrete Curing. .

C. All mixing, surface preparation, handling, placing, consolidation, and other means of execution for prepackaged grouts shall be done according to the instructions and recommendations of the manufacturer.

D. The Contractor, through the manufacturer of a non-shrink grout and epoxy grout, shall provide on-site technical assistance upon request, at no additional cost to the Owner

3.02 CONSOLIDATION

A. Grout shall be placed in such a manner, and with the consistency necessary for each application, so as to assure that the space to be grouted is completely filled.

3.03 GROUT INSTALLATION

A. Grout shall be placed quickly and continuously, shall completely fill the space to be grouted and be thoroughly compacted and free of air pockets. The grout may be poured in place, pressure grouted by gravity, or pumped. The use of pneumatic pressure or dry-packed grouting requires approval of the Engineer. For grouting beneath base plates, grout shall be placed from one side only and allowed to flow across to the open side to avoid air-entrapment.

- END OF SECTION -

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 siliconate based solution designed to harden, dustproof and protect concrete floors subjected to heavy vehicular traffic and to resist black rubber tire marks on concrete surfaces. The product must contain a minimum solids content of 20% of which 50% is siliconate. Acceptable products are Diamond Hard by the Euclid Chemical Company, 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 band floating with cork floats.

4. Type "D" - Steel Troweled: This finish shall be obtained after completion of a Type "B" finish. When the concrete has hardened sufficiently to prevent excess fine material from working to the surface, the surface shall be compacted and smoothed with not less than two thorough and complete steel troweling operations. In areas which are to receive a floor covering such as tile, resilient flooring, or carpeting, 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, Painting	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 Section 01300 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.

3.06 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 -

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 structural members shall conform to the requirements of Section 05140 entitled "Structural Aluminum".

D. All aluminum shall be provided with mill finish unless otherwise noted.

E. Where bolted connections are indicated, aluminum shall be fastened with Type 316 stainless steel bolts.

F. 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. Manufacturer’s installation instructions.

3. Welder certifications for each person who is to perform field welding. Certifications shall be from a recognized testing laboratory.

4. Certified weld inspection reports, when required.

5. Welding procedures.

6. Installer qualifications

7. Certification of Installer Training

8. Inspection Reports

9. Results of Anchor Proof Testing

10. 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: Drilled-in 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: 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. 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.

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 independant 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 G5” by ITW Redhead, “HIT HY-150 Max SD” by Hilti, Inc., “SET-XP” by Simpson Strong-Tie Co., or “Powers 1000+” 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 CITY.

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” by ITW Redhead, “HIT HY-150 Max” by Hilti, Inc., “SET Epoxy Tie” or “AT” by Simpson Strong-Tie Co., or “Powers AC 100+ Gold” or “T308+ Epoxy” 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 CITY.

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 (fy) less than 58 ksi nor an ultimate strength (fu) less than 72.5 ksi, unless noted otherwise. Where steel to be anchored is galvanized, concrete anchors shall also be galvanized unless otherwise indicated on the Drawings.

2. Concrete anchors used to anchor aluminum, FRP, or stainless steel shall be 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 25 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.

3.02 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.

3.03 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.

3.04 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."

3.05 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 05515 - LADDERS

PART 1 – GENERAL

1.01 REQUIREMENT

A. The Contractor shall furnish all materials, labor, and equipment required to provide all ladders in accordance with the requirements of the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 05010 – Metal Materials

B. Section 05050 – Metal Fastening

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of the Specifications, all work specified herein shall conform to the applicable requirements of the following documents.

1. Florida Building Code (FBC)

2. Aluminum Association Specifications for Aluminum Structures

3. Occupational Safety and Health Administration (OSHA) Regulations

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01300 entitled "Submittals".

1. Complete fabrication and erection drawings of all metalwork specified herein.

2. Other submittals as required in accordance with Section 05500 entitled "Metal Fabrications".

PART 2 – PRODUCTS

2.01 METAL MATERIALS

A. Metal materials, fasteners and welds used for ladders shall conform to Section 05010 entitled "Metal Materials", unless noted otherwise.

2.02 METAL FASTENING

A. All welds and fasteners used for ladders shall conform to Section 05050, Metal Fastening, unless noted otherwise.

2.03 VERTICAL LADDERS

A. Ladders shall be furnished with all mounting brackets, baseplates, fasteners, and necessary appurtenances for a complete and rigid installation.

B. All ladders shall be aluminum alloy 6061-T6 or 6063-T5 with a clear, anodized finish, Aluminum Association M12C22A41, unless noted otherwise.

C. All ladders shall conform to dimensions indicated on the Drawings and shall comply with OSHA requirements.

D. Side rails shall be 1-1/2 inch diameter Schedule 80 pipe, minimum.

E. Rungs shall be 1-inch wide striated top with semicircular bottom.

F. All exposed connections shall be welded and ground smooth.

G. Ladders shall be as manufactured by Thompson Fabricating Company, or equal.

H. All fixed ladders terminating below a roof, floor or wall shall be provided with Bilco Model 2 Ladder Up Safety Posts, or equal. The safety post system components shall be suitable for service in a corrosive environment. The safety posts shall be manufactured of high strength, hot dip galvanized steel with telescoping tubular sections that lock automatically when fully extended. Upward and downward movement shall be controlled by a stainless steel spring balancing mechanism. The safety posts shall be completely assembled with fasteners for securing to the ladder rungs in accordance with the manufacturer's recommendations.

2.04 LADDER SAFETY SYSTEM

A. Ladders with an uninterrupted length exceeding 24 ft between landings or floors shall be installed with a ladder safety system, unless indicated otherwise on the drawings.

B. Ladder safety system shall comply with OSHA requirements and meet ANSI A14.3 requirements.

C. Ladder system shall include all necessary components to provide a fully operational system, including one full body safety harness with a 310 lb. weight capacity for each ladder safety system.

D. Ladder Safety Systems shall be Miller Vi-Go by Honeywell, LAD_SAF by DBI Sala, or approved equal.

PART 3 – EXECUTION

3.01 FABRICATION

A. All measurements and dimensions shall be based on field conditions and shall be verified by the Contractor prior to fabrication. Such verification shall include coordination with adjoining work.

B. All fabricated work shall be shop fitted together as much as practicable, and delivered to the field, complete and ready for erection.

C. All work shall be fabricated and installed in a manner that will provide for expansion and contraction, prevent shearing of bolts, screws, and other fastenings, ensure rigidity, and provide a close fit of sections.

D. Finished members shall conform to the lines, angles, and curves shown on the Drawings and shall be free from distortions of any kind.

E. All shearings shall be neat and accurate, with parts exposed to view neatly finished. Flame cutting is allowed only when performed utilizing a machine.

F. All shop connections shall be welded unless otherwise indicated on the Drawings or specified herein. All fastenings shall be concealed where practicable.

G. Fabricated items shall be shop painted when specified in accordance with Section 09900 entitled "Painting".

3.02 INSTALLATION

A. Assembly and installation of fabricated system components shall be performed in strict accordance with manufacturer's recommendations.

B. All ladders shall be erected square, plumb and true, accurately fitted, adequately anchored in place, and set at proper elevations and positions.

C. Metalwork shall be field painted when specified in accordance with Section 09900 entitled "Painting".

- 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 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 Sound 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 and Section 11000, Equipment General Provisions. 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 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.

2.03 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.

2.04 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.

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 (NOT USED)

DIVISION 8 – DOORS AND WINDOWS (NOT USED)

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-epoxy fillers 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 then one shop coat and two field coats, or one prime coat and two finish coats of the appropriate paint. Items to be painted include, but are not limited to, exterior and interior concrete, structural steel, miscellaneous metals, steel and aluminum doors and frames, concrete block, ductwork, sluice gates, operators, pipe fittings, valves, mechanical equipment, motors, conduit, and all other work which is obviously required to be painted unless otherwise specified.

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 1.10 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

C. Section 15030 - Piping and Equipment Identification Systems

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, Sherwin Williams, or equal.

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 proposed for 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) project references which show that the painting applicator or subcontractor has previous successful experience with the specified or comparable coating systems, a list of installations that are currently in service and documentation that applicator or subcontractor is currently a qualified applicator of the proposed coatings by the manufacturer. Include the name, address and telephone number of the owner of each installation for which the coating applicator provided the coating.

E. CERTIFICATIONS: The coating manufacturer shall submit the following certifications:

1. A letter from the coating manufacturer stating that the specified material is suitable for the application.

2. Inspection reports of coating manufacturer certifying that all inspections by the manufacturer as specified in 09900-1.07(B) showed satisfactory performance of the work by the coating applicator.

3. A letter from the coating manufacturer certifying that the surface preparation has been properly completed.

4. A letter from the coating manufacturer certifying that the coating system has been properly applied and acknowledging that their warranty is in effect.

5. A sample copy of the warranty to be issued after completion of the work.

6. Test reports of all testing and inspections during the work.

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

I. Thinner and use of thinner

j. Temperature and relative humidity limitations during application and after application

k. Time allowed between coats

l. Protection from sun

m. Physical properties of paint including solids content and ingredient analysis

n. Surface preparation

o. Touch up requirements and limitations

C. Concrete surfaces specified by the paint manufacturer to be acid etched shall be etched in accordance with the manufacturer's instructions. The surface shall then be thoroughly scrubbed with clean water, rinsed, and allowed to dry. The surface shall be tested with a moisture meter to determine when dry before coating. The surface shall also be tested for pH to determine the acid has been properly neutralized.

1.09 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. Require that personnel perform work in strict accordance with the latest requirements of OSHA Safety and Health Standards for construction. Meet or exceed requirements of regulatory agencies having jurisdiction and the manufacturer's published instructions and recommendations. Maintain a copy of all Material Safety Data Sheets at the job site of each product being used prior to commencement of work. Provide and require that personnel use protective and safety equipment in or about the project site. Provide respiratory devices, eye and face protection, ventilation, ear protection, illumination and other safety devices required to provide a safe work environment.

B. Respirators shall be worn by persons engaged or assisting in spray painting. The CONTRACTOR shall provide ventilating equipment and all necessary safety equipment for the protection of the workmen and the work.

C. All paint shall comply with all requirements of the Air Pollution Regulatory Acts concerning the application and formulation of paints and coatings for an area in which the paints are applied. Specifically, paints shall be reformulated as required to meet the local, State and Federal requirements.

1.11 SURFACES NOT TO BE COATED

A. The following items shall not be coated unless otherwise noted:

1. Encased piping or conduit.

2. Stainless steel work.

3. Clear PVC secondary containment piping.

4. Galvanized checkered plate.

5. Aluminum handrails, walkways, windows, louvers, grating and checkered plate.

6. Flexible couplings, lubricated bearing surfaces and insulation.

7. Packing glands and other adjustable parts of mechanical equipment.

8. Finish hardware.

9. Steel encased in concrete or masonry

10. Plastic switch plates and receptacle plates.

11. Signs and nameplates.

12. Any code-required labels, such as Underwriters' Laboratories and Factory Mutual, or any equipment identification, performance rating, name or nomenclature plates.

13. Any moving parts of operating units, mechanical and electrical parts, such as valve and damper operators, linkages, sensing devices, motor and fan shafts, unless otherwise indicated.

1.12 QUALITY WORKMANSHIP

A. The Contractor shall be responsible for the cleanliness of his painting operations and shall use covers and masking tape to protect work whenever such covering is necessary, or if so requested by the Owner. Any unwanted paint shall be carefully removed without damage to any finished paint or surface. If damage occurs, the entire surface, adjacent to and including the damaged area, shall be repainted without visible lapmarks and without additional cost to the Owner.

B. Painting found defective shall be scraped or sandblasted off and repainted as the Owner may direct. Before final acceptance of the work, damaged surfaces of paint shall be cleaned and repainted as directed by the Owner.

1.13 ADDITIONAL PAINT

A. At the end of the project, the Contractor shall turn over to the Owner a one gallon can (single component material) or small kit (multi component material – minimum of one gallon yield) of each type and color of paint, primer, thinner or other coating used in the field painting. The material shall be delivered in unopened, labeled cans as it comes from the factory. The manufacturer's literature describing the materials and giving directions for their use shall be furnished in three bound copies. A type-written inventory list shall be furnished at the time of delivery.

1.14 WARRANTY

A. The coating manufacturer shall provide a standard material product warranty for a period of 5 years from the date of substantial completion.

1.15 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 3.07, of this Section entitled "Paint Schedule". Table 09900-1 lists Tnemec products as a reference. Equivalent products by the manufacturers listed in Article 1.03 of this Section may be submitted for review.

Table 09900-1
Product Listing

Ref. No.	Description	MANUFACTURERS REFERENCE Tnemec
105	Polyamidoamine Epoxy	N69 – Hi-Build Epoxoline II
110	Acrylic Polyurethane	1074U Endurashield
111	Modified Waterborne Acrylate	156 - Envirocrete (Smooth Texture)
114	Waterborne Modified Polyamine Epoxy	151-1051 Elasto-Grip
115	Aromatic Urethane, Zinc Rich	90-97 Tneme-Zinc
118	Epoxy Modified Cementitious Mortar	218 MortarClad
131	Modified Polyamine Epoxy Primer	201 Epoxoprime
132	Fiber Reinforced Novolac Epoxy	270 Stranlok
133	Polyamine Novolac Epoxy	282 Tneme-Glaze

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. Threaded portions of valve and gate stems, machined surfaces which are limited for sliding contact, surfaces which are to be assembled against gaskets, surfaces or shafting on which sprockets are to fit, or which are intended to fit into bearings, machined surfaces of bronze trim on slide gates and similar surfaces shall be masked off to protect them from the sandblasting of adjacent surfaces. Cadmium-plated or galvanized items shall not be sandblasted unless hereinafter specified, except that cadmium-plated, zinc-plated, or sherardized fasteners used in assembly of equipment to the sandblasted shall be sandblasted in the same manner as the unprotected metal. All installed equipment, mechanical drives, and adjacent painted equipment shall be protected from sandblasting. Protection shall prevent any sand or dust from entering the mechanical drive units or equipment where damage could be caused.

3. 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.

4. Examine surfaces to be coated to determine that surfaces are suitable for specified surface preparation and painting. Report to Engineer surfaces found to be unsuitable in writing. Do not start surface preparation until unsuitable surfaces have been corrected. Starting surface preparation precludes subsequent claim that such surfaces were unsuitable for the specified surface preparation or painting.

5. Surface preparation shall be in accordance with specifications and manufacturer's recommendations. Provide additional surface preparation, and fill coats where manufacturer recommends additional surface preparation, in addition to requirements of specification.

6. Touch-up shop or field applied coatings damaged by surface preparation or any other activity, with the same shop or field applied coating; even to the extent of applying an entire coat when required to correct damage prior to application of the next coating. Touch-up coats are in addition to the specified applied systems, and not considered a field coat.

7. Protect motors and other equipment during blasting operation to ensure blasting material is not blown into motors or other equipment. Inspect motors and other equipment after blasting operations and certify that no damage occurred, or where damage occurred, the proper remedial action was taken

8. 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.

9. Field paint shop painted equipment in compliance with Color Coding and as approved by Engineer.

B. Metal Surfaces

1. Conform to current The Society for Protective Coatings Standards (SSPC) Specifications for metal surface preparation. Use SSPC-Vis-1 pictorial standards or NACE visual standards TM-01-70 or TM-01-75 to determine cleanliness of abrasive blast cleaned steel.

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. 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.

4. 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.

5. 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.

6. 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.

7. 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.

8. Prime cleaned metals immediately after cleaning to prevent rusting.

9. Clean rusted metals down to bright metal by sandblasting and immediately field primed.

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, contaminants, open bugholes, surface voids, air pockets, and other subsurface irregularities using blasting or grinding. Do not expose underlying aggregate. Use dry, oil-free air for blasting operations. Surface texture after blasting shall achieve profile as required by manufacturer or where not defined by manufacturer similar to that of medium grit sandpaper. Remove residual abrasives, dust, and loose particles by vacuuming or other approved method. 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.

5. Surface defects, such as hollow areas, bugholes, honeycombs, and voids shall be filled with polymeric filler compatible with painting system. Complete fill coats may be used in addition to specified painting system and as approved by the Engineer. Fins, form marks, and all protrusions or rough edges shall be removed.

6. Repair existing concrete surfaces which are deteriorated to the point that surface preparation exposes aggregate with fill coats or patching mortar as recommended by paint manufacturer and as directed by the Engineer.

7. Clean concrete of all dust, form oils, curing compounds, oil, tar, laitance, efflorescence, loose mortar, and other foreign materials before paints are applied.

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.

J. Castings

1. Prepare castings for painting by applying a brush or a knife-applied filler. Fillers are not to be used to conceal cracks, gasholes, or excessive porosity.

2. Apply one coat of primer with a minimum thickness of 1.2 mils in addition to coats specified. Allow sufficient drying time before further handling.

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 in strict accordance with pain manufacturer’s recommendations and as specified herein. 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 approved equal. DFT shall mean the total minimum dry film thickness per application measured in mils. Products are referenced by numbers listed in Article 2.01, “Materials,”

and listed in Table 09900-1. The paint schedule identifies the minimum DFT required per coat. If the CONTRACTOR does not achieve the specified DFT range in a single coat, he shall provide additional coats as necessary at no additional cost to the OWNER.

B. Metal Surfaces, Exterior (Atmospheric) Exposure

1. Metal surfaces exposed to the atmosphere that do not come into contact with corrosive atmospheres including the following types of surfaces shall be painted as described below:

a. Above ground piping, valves, and pipe supports.

b. Miscellaneous steel shapes, angles, etc.

c. Exposed surfaces of conduit, duct work, etc.

Ferrous Metal

Application	No.	Description	DFT
First -1 coat	115	Aromatic Urethane Zinc Rich	2.0 - 4.0
Second - 1 coat	105	Polyamidoamine Epoxy	4.0 - 6.0
Finish - 1 coat	110	Acrylic Polyurethane	2.0 - 3.0
		Min. Total	10.0 Mils

Non-Ferrous Metal

Application	No.	Description	DFT
First - 1 coat	105	Polyamidoamine Epoxy	2.0 - 3.0
Second - 1 coat	110	Acrylic Polyurethane	2.0 - 3.0
		Min. Total	5.0 Mils

C. PVC/CPVC Pipes, Exterior or Interior Exposure

1. PVC and CPVC pipes, valves, and accessories, shall be painted as follows:

Application	No.	Description	DFT
First - 1 coat	105	Polyamidoamine Epoxy	2.0 - 3.0
Finish - 1 coat	110	Acrylic Polyurethane	2.0 - 3.0
		Min. Total	4.0 mils

D. Concrete Surfaces For Secondary Containment of Chemicals / Liner:

a. Concrete surfaces within containment area (includes all containment slabs and walls, floors, equipment pads, sump walls and slab). Chemical fill station shall also be coated with the following system.

Application	No.	Description	DFT
Surfacer*	118	Epoxy Modified Mortar	1/16 inch

First - 1 coat	131	Epoxy Primer	6.0 - 10.0
Brush - 1 coat	132	Fiber Reinforced Novolac Epoxy	25.0 - 40.0
Finish - 1 coat**	133	Novolac Epoxy	8.0 - 10.0
		Min. Total	48.0 Mils

* *Surfacer shall be applied on vertical surfaces.*

** *Nonskid aggregate shall be utilized with Tnemec Series 282 with a uniform consistent finish.*

E. Existing Concrete and Masonry Surfaces requiring Touch-Up caused by CONTRACTOR's construction activities, Exterior Exposure

1. Exterior exposed concrete surfaces requiring touch-up caused by CONTRACTOR's construction activities shall be painted as described below: Paint colors and color scheme shall match existing.

Application	No.	Description	DFT
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	4.0 - 6.0
		Min. Total	10.0 Mils

**(Apply a brush coat of TNEMEC Series 156 Enviro-Crete or equal into all exposed cracks prior to application of finish coat.)*

F. New Concrete and Masonry Surfaces, Exterior Exposure

1. The exterior above grade surfaces of all new structures shall receive the following:

Application	No.	Description	DFT
First - 1 coat	111	Modified Waterborne Acrylate	4.0 - 6.0
Finish - 1 coat	111	Modified Waterborne Acrylate	4.0 - 6.0
		Min. Total	10.0 Mils

3.04 PAINTING

A. Application: 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.

4. Special attention shall be given to nuts, bolts, edges, angles, flanges, etc., where insufficient film thicknesses are likely. Stripe paint prior to applying prime coat. Stripe painting shall be in addition to coats specified.

5. Perform thinning in strict accordance with the manufacturer's instructions, and with the full knowledge and approval of the Engineer and paint manufacturer.

B. Drying Time: A minimum of twenty-four hours drying time shall elapse between applications 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.

10. Paint manufacturer or his representative shall provide their services as required by the Engineer. Services shall include, but not be limited to, inspecting existing paint, determination of best means of surface preparation, inspection of completed work, and final inspection of painted work 11 months after the job is completed.

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.

M. Take all necessary precautions to contain dispersion of sandblasting debris and paint to the limits of the work. Take into account the effect of wind and other factors which may cause dispersion of the sandblasting debris and paint. Suspend painting operations when sanding debris or paint cannot be properly confined. Assume all responsibilities and cost associated with damage to adjacent structures, vehicles, or surfaces caused by the surface preparation and painting operations.

3.05 SCHEDULE OF COLORS

A. All colors shall be designated by the ENGINEER during shop drawing review. The CONTRACTOR shall submit color samples to the ENGINEER as specified in Article 1.04. The CONTRACTOR shall submit suitable samples of all colors (including custom colors as may be required) 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 OWNERS approval. 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.

3.07 OSHA SAFETY COLORS

A. Items listed in ANSI Z53.1-1971, Section 2.1 shall be painted ANSI Red. In general, these items shall include fire protection equipment and apparatus; wall mounted breathing apparatus, danger signs and locations; and stop bars, buttons or switches. In addition all hose valves and riser pipes, fire protection piping and sprinkler systems, and electrical stop switches shall be painted ANSI Red.

B. Items listed in ANSI Z53.1-1971, Section 2.3 shall be painted ANSI Yellow. Yellow shall be the basic color for designating caution and for marking physical hazards such as striking against, stumbling, falling, tripping, and "caught in between". In addition, an 8-inch wide strip on the top and bottom tread of stairways shall be coated.

3.08 WORK IN CONFINED SPACES

A. The CONTRACTOR shall provide and maintain safe working conditions for all employees. Fresh air shall be supplied continuously to confined spaces through the combined use of existing openings, forced-draft fans, or by direct air supply to individual workers. Paint fumes shall be exhausted to the outside from the lowest level in the contained space.

B. Electrical fan motors shall be explosion proof if in contact with paint fumes. No smoking or open fires will be permitted in, or near, confined spaces where painting is being done.

3.09 CLEANING

A. The buildings and all other Work areas shall be at all times kept free from accumulation of waste material and rubbish caused by the Work. At the completion of the painting, all tools, equipment, scaffolding, surplus materials, and all rubbish around and inside the buildings shall be removed and the Work left broom clean unless otherwise specified.

- END OF SECTION -

DIVISION 10 – SPECIALTIES

SECTION 10400 – IDENTIFYING DEVICES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Furnish 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
3. Plaque

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. Site Signage
    a. Mowhawk Sign Systems
    b. Innerface Architectural Signage Incorporated

c. Gemini Incorporated

d. Or Equal

2. Exterior and Interior Scheduled Signage

a. Seton Corporation

b. Safety Sign a division of Brimar Industries, Inc.

c. Emedco

d. Or Equal

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 (Not Used)

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 (Not Used)

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 the 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 while 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.

2.05 EXIT ROUTE SIGNS (Not Used)

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.

2.06 INTERIOR ROOM NAME AND NUMBER SIGNS (Not Used)

A. CONTRACTOR shall provide and install interior room name and number signs for all rooms shown on the Drawings. Signs shall comply with the Americans with Disabilities Act. All signs shall have white raised letters and numbers chemically fused to 1/8" blade acrylic plastic, gray background. 2-inch high x 6-inch minimum width for sign or longer where nomenclature demands or as required by the American Disability Act. Provide 3/8" radius corners. Lettering shall be upper case Helvetica style.

B. Mounting: Non-removable oral-head screws, using raw plugs where mounted on masonry or concrete surfaces. Mounting on acoustical partitions as recommended by manufacturer.

2.07 FIRE EXTINGUISHER SIGNS 9 (Not Used)

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 18" red acrylic plastic background. Signs shall be 1 1/2" high x length required reading "FIRE EXTINGHISHER INSIDE". Doors with these signs shall remain unlocked at all times the facility is occupied including nighttime uses.

2.09 SIGN SCHEDULE FOR CHEMICAL AREA

A. In addition to the signs previously specified, the CONTRACTOR shall provide and install signs according to the sign and label schedule summarized in Table 10400-1 for the chemical area. The 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.

Table 10400-1 Sign and Label Schedule – OFDB Odor Control Facility					
Sign Wording or *Type of Sign*	**Minimum Size (in.) H x W**	**Type**	**Lab Safety Supply Reference No.**	**Quantity**	**Locations**
Safety Signs					
EMERGENCY SHOWER AND EYEWASH (Spanish and English)	14 X 10	Aluminum Sign	9S-42021-AL	1	At emergency shower and eyewash
Information Signs					
SODIUM HYPOCHLORITE FILL	4 x 4	Aluminum Sign	Custom	1	At sodium hypochlorite fill station
SODIUM HYDROXIDE FILL	4 X 4	Aluminum Sign	Custom	1	At sodium hydroxide fill station
Safety Labels					
DANGER CORROSIVE AVOID CONTACT WITH EYES AND SKIN	3.5 X 5	Adhesive Label	61684	2	Near chemical metering pumps
NFPA DIAMOND for Sodium Hydroxide	6 X 6	Adhesive Label or Aluminum Sign	Custom	3	On storage tank, fill station and near metering pumps
NFPA DIAMOND for Sodium Hypochlorite	6 X 6	Adhesive Label or Aluminum Sign	Custom	3	On storage tank, fill station and near metering pumps
WARNING “NON-POTABLE WATER DO NOT DRINK”	6 X 6	Adhesive Label or Aluminum Sign	Custom	1	All hose bibs

CONTRACTOR shall provide additional signage in addition to signage indicated on Schedule as required to meet all regulatory and building department requirements.

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 -

SECTION 10524 – EMERGENCY EYEWASH / SHOWER STATIONS

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. Furnish and install emergency eyewash / shower stations as shown on the Drawings and as specified herein.

B. Coordinate work in this Section with painting and marking as specified in Section 09900 entitled, “Painting” and with Instrumentation as noted in Division 17.

1.02 SUBMITTALS

A. General: Submit in accordance with Section 11000 entitled, “Equipment General Provisions” and Section 01300 entitled, “Submittals”.

B. Shop Drawings: Shop drawings shall include the following:

1. Manufacturer’s literature illustrating compliance with this specification.

2. Wiring diagram for the alarm horn and light system along with the flow switch.

C. Operation and Maintenance Instructions: Submit operation and maintenance data in accordance with Section 01300 entitled, “Submittals”.

1.03 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Specifications provide products from one of the following manufacturers:

1. Haws

2. Or Equal

PART 2 – PRODUCTS

2.01 EMERGENCY EYEWASH AND SHOWER STATIONS

A. General: Furnish and install a combination emergency shower and eye wash unit where shown on the Drawings.

B. Construction:

1. Shower Head: 10-inch stainless steel

2. Eyewash: stainless steel eye wash bowl equipped with stainless steel dust cover that protects the eyewash assembly and face spray ring from airborne contaminants.

3. Pull Rod: Furnish with a stainless steel pull rod that activates shower. Rod shall include a triangular handle.

4. Foot Treadle: Foot treadle shall activate the eyewash.

5. Push Flag: Furnish with a push flag to activate the eyewash in addition to the foot treadle.

6. Pipe and fitting: 1-1/4" Type 304 stainless steel.

7. Supply and Waste: 1-1/4" IPS.

8. Certification: Equipment shall be certified by CSA to meet the ANSI Z358.1 Standard for Emergency Eyewash and Shower Equipment.

C. Scald Protection Valves: Equip all exterior mounted shower/eyewash stations with scald protection valves supplied by the shower/eyewash stations manufacturer. Scald protection valves shall be furnished on the shower head and the eyewash station. The scald protection valves shall begin to open at 85 degrees Fahrenheit and be fully open at 100 degrees Fahrenheit. Other temperature ranges for the scald protection valve will not be accepted.

D. Flow Control Devices: Units shall be complete with automatic flow control devices as required to limit emergency shower flow to 20 gpm and eye wash flow to 3 gpm.

E. Model: Combination units shall be Haws Model No. 8330, Bradley Model 219-314SS16, or equal.

2.02 ALARM HORN AND LIGHT SYSTEM

A. General: All emergency eyewash and shower stations shall be equipped with flow switch that activates an emergency alarm horn and alarm light system. The flow switch, alarm horn, alarm light and associated wiring and mounting brackets shall be supplied by the same manufacturer as the emergency eyewash and shower stations.

B. Alarm Horn: 90 db sound output at 10 feet.

C. Alarm Light: Flashing amber light.

D. Flow Switch – DPDT: Brass double pole, double throw flow switch that activates the alarm horn, the alarm light and extra set of dry contacts for connection with the PLC-33. The signal voltage shall be 24VDC sourced from LCP-33.

E. Operation: Alarm system shall activate when the emergency shower or eyewash is in use.

F. Mounting Brackets: Furnish alarm unit with mounting brackets for mounting on a wall within 5 feet of the proposed location for the eyewash and shower station.

G. Alarm System Power Requirements: 120 volts, single phase, 60 Hz.

H. Model: Haws Model 9001, Bradley Model S19-319S4, or equal.

I. Wiring to Plant Control System: Conduit and wiring from the flow switch to the plant control system is the responsibility of Division 16.

2.03 SCHEDULE

A. The following schedule lists the emergency eyewash and shower stations to be supplied under this project.

Quantity	Location	Service Indoors / Outdoors
2	Oxygenation Flow Distribution Box – Odor Control System	Outdoors

PART 3 -- EXECUTION

3.01 INSTALLATION

A. Eyewash and shower stations shall be installed where shown on the Drawings or as directed by the ENGINEER. Where required by OSHA regulations, the background of the mounting location shall be painted the appropriate color.

B. Emergency shower/eyewash stations shall be installed per manufacturer's installation instructions.

C. Field route drain piping and water supply piping as required for the installation.

- 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 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 ½, ¾, and full load; slip at full load; running, full load, and locked rotor current values; and safe running time-current curves.

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.

1.04 OPERATION AND MAINTENANCE INSTRUCTION/MANUALS

A. Operation and Maintenance (O&M) manuals shall be submitted in accordance with Section 01300, Submittals.

B. O&M manuals shall include instructions, equipment ratings, technical bulletins, and any other printed matter such as wiring diagrams and schematics, prints or drawings, containing full information required for the proper operation, maintenance, and repair of the equipment. Included in this submission shall be a spare parts diagram, complete spare parts list, bill of

materials, OEM part numbers and manufacturer's catalog information of all equipment components.

C. Each set of instructions shall be bound together in appropriate three-ring binders with a detailed Table of Contents..

D. Written operation and maintenance instructions shall be required for all equipment items supplied for this project. The amount of detail shall be commensurate with the complexity of the equipment item.

E. Information not applicable to the specific piece of equipment installed on this project shall be struck from the submission.

F. Information provided shall include a source of replacement parts and names of service representatives, including address and telephone number.

G. Extensive pictorial cuts of equipment are required for operator reference in servicing.

H. When written instructions include Shop Drawings and other information previously reviewed by the ENGINEER, only those editions thereof which were approved by the ENGINEER, and which accurately depict the equipment installed, shall be incorporated in the instructions.

1.05 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.

1.06 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.

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 owner 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 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 Section 05120, Structural Steel.

B. All materials shall conform to applicable provisions of the AISC Specifications for the design and fabrication of structural steel, and to pertinent ASTM Standard Specifications.

2.04 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 Section 05035, Galvanizing.

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. 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.

C. Where variable frequency drives (VFDs) are specified, the CONTRACTOR shall be responsible for coordinating between equipment supplier and VFD supplier to ensure a complete and operational system. VFDs shall be furnished under Division 16 and shall be as specified in Section 16495, Variable Frequency Drive Systems.

D. 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. Each pump and other piece of mechanical equipment shall also be identified as to name and number by a suitable laminated plastic or stainless steel nameplate mechanically fastened with stainless steel hardware; for example, "Raw Water Pump #1". Coordinate name and number with same on remotely located controls, control panel, and other related equipment.

C. Nameplates shall not be painted over.

PART 3 – EXECUTION

3.01 SHOP TESTING

A. All equipment shall be tested in the shop of the manufacturer in a manner which shall conclusively prove that its characteristics comply fully with the requirements of the Contract Documents and that it will operate in the manner specified or implied.

B. No equipment shall be shipped to the project 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 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 owners 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 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 taping of all training sessions. Completed, labeled tapes 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 +/- 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 +/- 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 (+/- .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 Section 11100, Pumps-General, 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 Section 16000, Basic Electrical Requirements.

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 Mechanalysis, Bentley, Nevada.

F. 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.

G. 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.

H. 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.

I. Noise or vibration in any rotating equipment which the ENGINEER judges to be excessive or damaging, 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 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 11371 – PACKAGED INSTRUMENT AIR SUPPLY SYSTEM

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The CONTRACTOR shall furnish, install, test, paint and place in satisfactory operation two air compressors complete with separators, two receivers, cycling refrigerated air dryer, air filter, piping, valves, starters, controls, accessories and associated appurtenances as required for a complete and operating system, as specified and as shown on the Drawings.

B. These specifications are intended to provide 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 materials, equipment and appurtenances for the packaged instrumentation air supply system complete as herein specified, whether or not specifically stated in the Specifications.

C. All necessary accessory equipment, appurtenances, spare parts, special tools, base attachments and mountings shall be provided for a complete and satisfactory operating system whether or not specifically stated in the Specifications. 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 the regular operating personnel in the care, operation, and maintenance of all equipment.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 11000 – Equipment General Provisions

B. Section 09900 – Painting

B. Section 15000 – Basic Mechanical Requirements

B. Division 16 - Electrical

B. Division 17 - Instrumentation

1.03 MANUFACTURERS

A. The equipment covered by these specifications is intended to be standard equipment of proven performance as manufactured by reputable concerns. All equipment shall be the product of acceptable manufacturers who have built equipment of similar size and capacity for at least five years and who has in the opinion of the ENGINEER sufficient experimental and test data to confirm the design of the equipment specified.

B. 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.

C. The system shall be as assembled by Ingersoll-Rand or equal.

1.04 SUBMITTALS

A. Supply Shop Drawings in accordance with Section 01300 entitled Submittals, including the following:

1. Make, model, weight, and horsepower of each equipment assembly.
2. Manufacturer's catalog information, descriptive literature, and specifications.
3. Detailed mechanical and electrical drawings showing equipment fabrications. Include dimensions, size, and locations of connections to other Work.
4. External utility requirements such as air, power, and drain for each component.
5. Functional description of internal and external instrumentation and controls including list of parameters monitored, controlled, or alarmed.
6. Control panel elevation drawings showing construction and placement of operator interface devices and other elements.
7. Power and control wiring diagrams, including terminals and numbers.
8. Complete assembly and installation drawings including overall equipment layout and piping interconnection drawings.

B. The CONTRACTOR shall submit the following in addition:

1. Compressor, motor and package nameplate data.
2. A list of the manufacturer's special tools, spare parts and lubricants to be supplied, and a list of the items recommended to be kept on hand.
3. Startup checklist will be provided at the conclusion of startup.

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 Section 01300 - Submittals.

B. Two copies of a preliminary O&M manual shall be included in the shop drawing submittal. Without inclusion of these manuals, the submittal will be considered incomplete and will be returned without review.

1.06 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, testing and start-up 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 Public Utilities General Conditions and Division 1 (Section 01700 – Project Closeout). The services of the manufacturer's representative shall be provided for periods stated in the following schedule:

SYSTEM	INSTALLATION TRIP (DAYS)	OPERATION* TRIP (DAYS)
Instrument Air Supply System	1	1

* During the operation trip the Manufacturer shall instruct CITY's personnel.

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 present at the project.

1.07 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.

C. Nameplates shall not be painted over.

1.08 HARDWARE

A. All machine bolts, nuts and capscrews shall be of the hex head type and shall be furnished in 316 stainless steel. Hardware requiring special tools or wrenches shall not be used.

1.09 TOOLS, SUPPLIES AND SPARE PARTS

A. 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, and those parts which are identical for more than one size unit shall have the same number. The following spare parts shall be supplied for the instrumentation air supply system:

1. One set of all special tools required for normal operation and maintenance shall be provided.

2. One year supply of all recommended lubricating oils and grease.

3. Two sets of replacement drive belts for the compressors.

4. Two compressor air inlet filters.

5. Two compressor air filters.

6. Two compressor switches.

7. One complete compressor unit with motor to duplicate the other compressors for the system.

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.

D. Spare parts shall be packed in manufacturers standard factory packaging clearly labeled with the part number, name, quantity and the component for which they are intended. Parts such as gaskets and seals which can dry out or degrade over time shall be sealed in air tight plastic bags.

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.

PART 2 – PRODUCTS

2.01 DESCRIPTION OF SYSTEM

A. The air compressor system shall consist of two air compressors, two air receiving tanks, one air dryer, and one inlet air filter. Each air compressor shall be base mounted with remote tanks and have a duplex wall mount control panel complete with all controls necessary to maintain air in the receiver tank between 25 and 65 psi. The air dryer shall also have an integral control panel to maintain moisture free air in the distribution system. The system shall have an integral output filter to remove oil and other impurities from the distributed air. An automatic drain trap shall remove any condensate from the dryer and receiver tanks.

2.02 COMPRESSOR

A. The compressors shall be heavy duty, lubricated, air cooled reciprocating compressors rated for continuous, outdoor service such as Model 2545X7.5 as manufactured by Ingersoll-Rand, or equal.

B. The compressor shall be capable of delivering at least 23 CFM of free air at 125 psig full flow at a system ambient operating temperature of 100 degrees F. The compressor shall be capable of continuous or periodic flow operation 24 hours/day at rated capacities and pressures.

C. Performance criteria for the compressors shall be as follows:

Motor Horsepower	7.5 HP
Speed	825 RPM
Minimum operating air pressure	50 PSIG
Normal operating air pressure	125 PSIG
Maximum operating air pressure	200 PSIG
Actual delivery	27.1 ACFM each pump
Brakehorsepower	7.8HP each pump

D. Each compressor package shall also be equipped as follows:

- Heavy duty cast iron frame
- Dry type inlet filter silencer 10 Micron
- Stainless steel finger valves
- Nonadjustable, single piece connecting rods
- Oil splash lubrication system
- Heavy duty modular iron crankshaft
- Protective, replaceable crankshaft bushing
- Balanced four-ring piston with rings
- Heavy duty, nonadjustable long life, ball bearings
- Built-in air-cooled inter-cooler, featuring finned copper tubes to remove the inter-stage heat of compression and inter-cooler safety valve
  Oil fill cap
- Low Oil Level Switch in a NEMA 4 enclosure mounted on both pumps
- Air cooled after-cooler, built-in, sized for a 25º F approach temperature and shall be Model BG-50 as manufactured by Ingersoll Rand or equal.
- Cast iron compressor flywheel that transmits power acts as a cooling fan, and smoothes out pulses
- V-belt drive complete including belt drive adjustment arrangement
- Dry type inlet air filter/silencer
- Totally enclosed belt guard – OSHA approved
- Each air compressor shall have automatic dual control. When in the automatic position, a time delay shutdown sequencer will begin when the unit shall shutdown and cock itself for the next automatic restart. If air is needed at any time, unit shall load up

E. Motors:

1. In accordance with NEMA 4.
2. Type: Induction TEFC with Class F insulation.
3. Enclosure: Totally enclosed for outdoor installation.
4. Duty Cycle: Continuous and periodic
5. Horsepower: 7.5 Hp.
6. Rpm: 1800.
7. Volts: 480 Volt
8. Phase: 3-phase.
9. Frequency: 60-Hz.
10. Service Factor: 1.15.
11. Connected Load: Do not exceed motor nameplate horsepower rating for operating conditions.
12. Minimum Full-Load Efficiency: Not less than 93 percent.
13. Package Maximum Full Load amps @ 460 = 11 amps.
14. Wiring: NEMA 4 water tight.

F. The compressor control panel shall be provided with 460V, 3 phase, 60 Hz power. The panel shall include starters, control power transformers and all necessary circuit breakers, equipment protective devices, control logic and circuitry, including lightning and surge suppressors for a complete working system. Panel enclosure shall be NEMA 4X construction. CONTRACTOR shall provide main disconnect and individual disconnect for each compressor as part of panel. Panel shall be located as shown on the Drawings and/or as directed by the ENGINEER.

G. The Control Panel shall include controls for automatic system operation with provisions for manual override. The panel shall provide controlled starting, stopping and protection of the compressors. Control panel shall provide a selection between automatic and hand operation mode for each compressor. In automatic mode, start and stop of compressor shall be controlled by pressure switches installed inside of compressor package. Lead and lag compressor start, stop and running time shall be controlled by the control panel. The lead compressor shall start when pressure in the receivers drops below an adjustable pressure level and shall stop when 125 psig is reached. Lag compressor shall be started when pressure drops further or when running timer of lead vacuum pump is elapsed. Lead and lag compressors shall alternate after every running cycle. In manual mode the compressors shall turn on and operate individually. However, the pressure switches shall act as an interlock to stop compressor to prevent excessive pressure conditions in the system.

H. A panel mounted indicator light shall be provided for each of the conditions described below. The air compressors control panel shall monitor and shut down each compressor for any of the following reasons:

1. High Air Temperature
2. Compressor Motor Overload

I. Circuitry shall be furnished in the air compressor control panel to provide DPDT dry contact outputs (5A, 115 VAC) for each of the following conditions.

1. Compressor Fail
2. Compressor Running

J. The following additional panel mounted indicators / controls shall be provided for each compressor:

1. Hand / off / auto selector switch
2. Reset pushbutton
3. Power on switch
4. Power on indicator light
5. Compressor run/fault indicator light

K. The compressor system shall include check valves, relief valves, and other safety components as necessary to ensure trouble free operation. For each compressor, all above components except control panels shall be mounted on a fabricated steel baseplate with forklift access holes including all interconnecting piping and electrical wiring, requiring only a single point electrical power connection, from a Contractor supplied local disconnect switch and a connection to the compressor control panel.

2.03 AIR RECEIVERS

A. Two air receivers shall be provided. Each Air Receiver shall be equipped as follows:

1. 240 gallon, 30-inch by 7-foot high vertical welded steel receiver bearing ASME code stamp and inspection openings.
2. Maximum Allowable Working pressure: 200 psig.
3. Corrosion Allowance: 1/16 inch.
4. Safety relief valve set for 110 psig.
5. Pressure gauge with gauge cock.
6. Automatic condensate drain valve with isolation valve. Power shall be 120V AC, 1 Phase 60Hz from either the compressor, control panel or dryer control panel.
7. Manual blowdown valve located at low point in receiver.
8. Epoxy coated inside and out, 5 to 6 mils DFT.

2.04 CYCLE REFRIGERATED AIR DRYER

A. The refrigerated air dryer shall be selected by the system manufacturer. The dryer shall meet the following performance requirements:

Capacity: 75 CFM
Maximum Pressure: 232 PSIG
Voltage: 115 volt, 1 phase, 60hz
Compressor Horsepower: 1/2 HP

Running Current: 4.8 Amps
Pressure Dew Point: NFPA Class H 38 F (based on 100 F inlet, 100 F ambient)
Sound Level: 58.5 dBA
Pressure Drop: 2.2 PSIG
Airflow across Condenser: 530 CFM
Thermo-Mass Glycol Capacity: 1.1 US gallon
The air dryer shall be Model RACT75 as manufactured by BEKO or equal.

B. The dryer shall incorporate a fully hermetic sealed refrigeration compressor/condenser, automatic expansion valve, and liquid refrigerant filter dryer. The dryer shall be charged with refrigerant 134A.

C. This refrigerated dryer package shall include all required starters, control circuitry, panels and appurtenances for proper operation of the complete system, including; refrigerator, compressor, fans and automatic drain trap. Control panel enclosure shall be NEMA 1.

D. A panel mounted indicator light shall be provided for each of the conditions described below. The dryer control panel shall monitor and shut down the dryer for any of the following conditions:

1. High Temperature

E. A circuit board shall be furnished in the dryer shall provide 12VDC alarm status output to indicate that the unit is in an alarm state.

F. The following additional panel mounted indicators/controls shall be provided:

1. Reset pushbutton
2. On / off switch
3. Power indicating light
4. Air outlet pressure gauge
5. Air inlet temperature gauge
6. Exchanger temperature gauge
7. Dryer fail indicating light
8. The dryer shall undergo refrigeration system evacuation and charging prior to shipment, including leak checks. The unit shall also be given a running test and calibration of instruments prior to shipment.
9. Dryer cabinet shall be chemically cleaned, prime coated, and finished with three (3) coats of high gloss baked enamel.

2.05 AIR FILTER

A. The filter shall be selected by the compressor manufacturer and shall be designed to remove oil and water liquid/mists and solid particles from compressed air. The filter shall have a capacity of 75 scfm at 125 psig air inlet pressure and shall have a maximum working pressure of 150 psig. It shall have filtering capability which exceeds the “Quality

Standard for Instrument Air" as defined by the Instrument Society of America. The filter shall be capable of removing oil and water liquid/mist down to 0.5 ppm by weight and have a micron rating of 0.01.

B. Filters shall remove up to 99% of all solid particles and droplets of water or oil before the air reaches the filter element.

C. The filter pressure drop at rated flow shall not be more than 1 psig when the element is new and the maximum pressure drop throughout the element shall not exceed 3 psi.

D. The expected element life at rated performance conditions shall be at least five (5) years.

E. The filter shall be equipped with a built-in pressure gauge and gauge cocks to measure pressure drop across the filter element, and an automatic drain trap to discharge contaminates.

2.06 PRESSURE REDUCING VALVE

A. Air Pressure Reducing Valve:

1. Manufacturer and Product: Fisher.
2. Fabrication: cast iron body with neoprene diaphragm.
3. Capacity: Reduce pressure to 40 psig from upstream pressure of 110 psig.

PART 3 – EXECUTION

3.01 INSTALLATION

A. General: CONTRACTOR shall install equipment on vibration isolators in accordance with manufacturer's instructions.

B. Piping: Equip with full-size flexible discharge connection, check valve, and isolation valve.

C. Air Compressor Piping:

1. Install in accordance with manufacturer's piping diagrams.

2. Pipe relief valve, tank drain, and separator to floor drain.

3.02 TESTING - GENERAL

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: None required.

2. Certified Shop Tests

   a. Manufacturers standard shop tests.

3. Motor tests.

4. Field Acceptance Tests: CONTRACTOR shall perform system operational test as specified below. Contractor shall provide certified copies of the test reports in accordance with Division 1 of the specifications. The system operational test shall consist of confirmation of the following:

   a. Compressor discharge pressure conforms to system criteria.

   b. Proper safety switch and safety valve operation.

   c. Crankcase vacuum within manufacturer's specifications.

   d. Compressor vibration is within manufacturer's specifications.

   e. Receiver tank leak check.

3.03 FINISHES

A. Manufacturer shall clean the exterior surfaces of the compressors, motors, receivers, dryer, filter, piping and valves, etc. prior to finishing, painting, or shipment.

B. Unpainted equipment, valves and piping constructed of galvanized steel shall pass the ASTM B-117 test for 220-hour salt spray solution (5%) without any sign of red rust.

C. Manufacturer shall paint outdoor units prior to shipment.

   1. Manufacturer shall apply a primer prior to painting units.

   2. Manufacturer shall apply a finish coat of acrylic polyurethane paint.

   3. Finished unit shall exceed 500-hour salt spray solution (5%) test without any sign of red rust when tested in accordance with ASTM B-117.

- END OF SECTION -

DIVISION 12 – FURNISHINGS

NOT USED

DIVISION 13 – SPECIAL CONSTRUCTION

SECTION 13121 – PRE-ENGINEERED METAL BUILDING SYSTEM

PART 1 - GENERAL

1.01 THE REQUIREMENT

A. The CONTRACTOR shall furnish, fabricate and install pre-engineered metal building systems where shown on the drawings, complete in accordance with the Drawings and the requirements of the Contract Documents.

B. The manufacturer shall design and fabricate the metal structural system including primary and secondary member connections, purlins, girts, roof and wall panels, bracings, fasteners, connections, sealants, gutters, downspouts, frame openings for louvers, doors and windows, anchor bolts, and all other parts required for a complete installation.

C. All steel shall be field painted in accordance with the requirements of section 09900, “Painting”.

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 05010 Metal Materials

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. Florida Building Code

2. AISC "Code of Standard Practice for Steel Buildings and Bridges."

3. AISC "Specifications for the Design, Fabrication, and Erection of Structural Steel for Buildings" and including the "Commentary of the AISC Specification."

4. AISC "Specifications for Structural Joints Using ASTM A 325 or A 490 Bolts" approved by the Research Council of Riveted and Bolted Structural Joints of the Engineering Foundation.

5. AWS Structural Welding Code AWS DI.1 and "Standard Qualification Procedure."

6. Metal Building Manufacturer's Association (MBMA) "Metal Building Systems Manual."

7. ALSC MB Category Metal Building Systems Certification.

8. All the codes and standards listed in the Section entitled "Cast-In-Place Concrete."

1.04 DESIGN CRITERIA

A. Building Description:

1. The building overall dimensions shall be as shown on the Drawings. Column locations shall be as shown on the Drawings unless otherwise accepted by the ENGINEER. The roof shall have a slope as indicated on the drawings.

B. Design Loads:

1. The metal building system shall be designed for the loads indicated in the Specifications and Drawings.

2. Dead Load shall be the total weight of the metal building including all attachments to the structure. Loads imposed on the building by piping, ductwork and other equipment shall be considered as dead load on the structure. All piping shall be assumed to be running full of sludge for design purposes

3. Roof live load shall be 20 PSF, or greater as required by the Florida Building Code, on the horizontal projection of the roof.

4. Wind load pressure shall be based on an ultimate design wind velocity of 180 MPH -3 second gust, Exposure C, corresponding to Risk Category III buildings and structures. Wind loads shall be calculated based upon the specified methods in the Florida Building Code and ASCE 7-16.

5. Equipment loads shall be as specified on the drawings.

6. Each member shall be designed to withstand the stresses resulting from the combinations of loads that produces the maximum percentage of actual to allowable stress in that member. Allowable stresses for combinations including wind may be increased by 33 1/2%, provided the member thus required is not less than that required for the combination of dead and live load.

7. Load combinations shall be as specified in ASCE 7-16.

1.05 SUBMITTALS

A. The CONTRACTOR shall submit shop drawings including manufacturer's erection drawings and design calculations of the metal building, in accordance with the Section entitled "Submittals." All shop drawings and design calculations shall carry the seal and signature of a Professional Engineer registered in the State of Florida.

B. Shop drawings shall conform to AISC recommendations and Specifications and shall show all openings, etc. required for other Work. Drawings shall include complete details showing all member and their connections, anchor bolt layouts, schedules for fabrication procedures, and diagrams showing the sequence of erection.

C. Manufacturer's product information, specifications, and installation instruction for building components and accessories.

D. Welder certifications shall be submitted for shop and field welders in triplicate, directly to the ENGINEER from a recognized testing laboratory, with copies to the CONTRACTOR and others as required.

E. Certification for grade and location of manufacture of all fasteners shall be submitted.

F. A color selection chart from the manufacturer shall be submitted indicating finish color on all exterior wall panels, trims and roof drainage accessories.

G. The metal building manufacturer shall furnish design calculations that demonstrate that the structural framing, roof and wall panels and its connections meet the design loads requirements.

H. The CONTRACTOR shall have unit responsibility for coordinating all equipment, piping and ductwork loads, piping and electrical work associated with the building on the design. The CONTRACTOR shall coordinate such data as is necessary.

I. Letter stating erector's qualifications as described in Article 1.06 below.

J. Miami-Dade Product Approvals or Florida Product Approvals for all building components and cladding.

1.06 QUALITY ASSURANCE

A. The building manufacturer shall have an ongoing quality control program encompassing materials, fabrication and delivery. The manufacturer shall have been engaged in the design of this type of building for at least five years.

B. Shop inspection may be required by the CITY at the CITY's expense. The CONTRACTOR shall give ample notice to the ENGINEER prior to the beginning of any fabrication Work so that inspection may be provided. The CONTRACTOR shall furnish all facilities for the inspection of materials and workmanship in the shop and inspectors shall be allowed free access to the necessary parts of the work. Inspectors shall have the authority to reject any materials or Work which does not meet the requirements of these Specifications. Inspection at the shop is intended as a means of facilitating the Work and avoiding errors, but it is expressly understood that it will in no way relieve the CONTRACTOR from its responsibility for furnishing proper materials or workmanship under this Specification.

C. The CITY may engage inspectors to inspect welded connections and to perform tests and prepare test reports.

1. Ten percent of all butt and bevel welds which extend continuously for 24 inches or less may be completely tested in accordance with AWS DI.1, Part B, Radiographic Testing of Welds, Chapter 6. All butt and bevel welds which extend continuously for more than 24 inches may be spot tested at intervals not exceeding 36 inches.

2. Welds that are required by the ENGINEER to be corrected shall be corrected or redone and retested as instructed, at the CONTRACTOR's expense by an acceptable independent testing lab and to the satisfaction of the ENGINEER.

D. CONTRACTOR shall furnish the name of erector proposed to use for this work including necessary evidence and/or experience records to ascertain their qualifications in the erection of metal buildings.

1.07 WARRANTIES

A. All work performed on this project shall be free from defective materials and workmanship for a period of five years from date of acceptance by the CITY. The building manufacturer shall provide a warranty on defective materials for a period of five years from acceptance.

B. The finish of the wall panels and roof panels shall be warranted by the building manufacturer for 10 years against blistering, peeling, cracking, flaking, chalking and chipping. Color change shall not exceed 5 NBS units as per ASTM D 2244. Caulking shall not be less than a rating of 8 as per ASTM D 659.

1.08 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Structural members shall be loaded in such a manner that they may be transported and unloaded without being over-stressed, deformed, or otherwise damaged.

B. Structural steel members and packaged materials shall be protected from corrosion and deterioration. Material shall be stored in a dry area and shall not be placed in direct contact with the ground. Materials shall not be placed on the structure in a manner that might cause distortion or damage to the members or the supporting structures. Damaged materials or structures shall be repaired or replaced as specified by the ENGINEER.

1.09 MANUFACTURERS AND BUILDERS

A. The pre-engineered metal building shall be as manufactured by United Structures of America, Houston, Texas, Butler Manufacturing or approved equal. The metal building shall be installed by a builder approved by the manufacturer.

1.10 COORDINATION

A. The CONTRACTOR shall properly coordinate building design and installation with other trades. Doors, roll-up doors, and louvers specified herein are not manufactured by the building manufacturer and will have to be provided and coordinated with the building installation by the CONTRACTOR.

PART 2 - PRODUCTS

2.01 STRUCTURAL MATERIALS

A. All structural and covering materials shall be new and meet physical design requirements. All structural steel shall be prime painted prior to shipping. All fabrication workmanship shall meet the fabrication tolerance as published by the MBMA.

B. Cold-formed sections shall be manufactured by precision roll or brake forming. All dimensions shall be true, and the formed members shall be free of fluting, bucking or waving. Cold formed sections shall conform to the requirements of Specification Section 05010, Metal Materials.

C. All structural shapes shall be made of hot-rolled steel sheets conforming to the requirements of specification Section 05010, "Metal Materials" plates and strip of built-up section shall have a minimum yield point of 50,000 psi.

D. All 14, 15 and 16 gage cold-formed sections shall have a minimum yield point of 50,000 psi.

F. All galvanized sheets and strips for structural framing shall conform to ASTM A 446, Grade "A."

2.02 STRUCTURAL FRAMING

A. Primary Frames

1. Primary framing shall be of rigid connections.

2. Roof beams and columns shall be welded up plate sections, tapered or uniform depth with solid web, complete for bolted field assembly.

3. All cap plates, compression plates, stiffener plates, and base plates shall be factory welded into place, and have the bolt connection holes shop fabricated.

4. Columns and roof beams shall be shop fabricated, complete with holes in flanges for the attachment of secondary structural members except for field work as noted on the manufacturer's erection drawings.

B. Endwall Framing

1. Endwall structural framing shall be achieved by primary framing specified herein. Channel framing will not be acceptable.

2.03 SECONDARY STRUCTURAL MEMBERS

A. Purlins, Girts and Eave Struts:

1. All steel purlins and girts, shall be “Z” sections either cold formed, hot-rolled, or built-up steel sections having a minimum yield point of 50,000 psi. Outer flanges of all girts and purlins shall contain factory-punched holes for panel connections and for connection to primary frames.

B. Bracing

1. Diagonal bracing shall be provided with rods. Cable bracing will not be acceptable. Where indicated on the drawings that portal frames are required, vertical diagonal bracing is not allowed and lateral load resistance in direction perpendicular to main frames shall be achieved with a bidirectional moment-resisting frame. Horizontal diagonal bracing shall be provided with rods. Cable type bracing will not be acceptable.

2. All diagonal bracing and sag rods, when required, shall be hot-rolled having a minimum yield point of 50,000 psi. Flange braces, purlin braces and sag rods, when required, shall be cold formed having a minimum yield point of 50,000 psi.

2.04 BOLTED AND WELDED CONNECTIONS

A. All field connections in main framing members shall be bolted, using high strength bolts, in accordance with the requirements of ASTM A 325. High strength bolts shall be hot dip galvanized. Field connections between main and secondary framing members shall be made with either ASTM A 325 or A 307 bolts. All ASTM A 307 bolts shall be hip dip galvanized. All bolted connections shall contain at least two bolts minimum.

B. The laying surfaces of all bolted connections shall be smooth and free from burrs or distortions.

C. All shop connections shall be welded in accordance with the American Welding Society "Structural Welding Code." Welding of steel sections shall be submerged arc or gas shielded arc process.

D. Anchorage: The building anchor bolts shall be designed to resist the column reactions. The diameter and layout of the bolts shall be as specified by the building manufacturer. The builder shall provide anchor bolts, anchor bolt setting plans and other information required by the CONTRACTOR to set the anchor bolts. Anchor bolts shall be threaded rods conforming to ASTM F 593 Type 316 stainless steel.

2.05 ROOF PANELING

A. The roof panels and connections shall have an Underwriters Laboratories uplift rating of

Class 90 and shall be capable of resisting wind, dead, and live load forces as specified in the Article 1.04 entitled "Design Criteria".

B. Roof panels shall be of the ribbed type. The panel material shall be min. 24 gage steel (or greater to resist specified loads) with a minimum yield of 42,000 psi. Finish shall be Zinc-Aluminum Alloy coated per ASTM A 792. Roof panels shall be painted with a fluoropolymer coating containing 70 percent “Kynar 500”. Roof system shall be PBR ribbed by United Structures of America, Butlerib II Roof System by Butler Manufacturing Company, or approved equal.

C. Panels shall be designed in accordance with AISC "Specifications for the Design of Light Gage Cold Formed Steel Structural Members" and in accordance with the specified loadings.

D. Roof panels shall be factory punched at panel ends to match pre-punched holes in structural members. Eave and splice panels shall have slots to provide for expansion and contraction.

E. The panels shall be precision roll-framed to provide width coverage of 2-feet minimum.

F. Ridge panels when required shall be one piece, factory covered to match the roof slope.

2.06 ROOF AND WALL FASTENERS

A. Roof and wall panels shall be attached to secondary framing members by No. 410 stainless steel self-drilling screws with weather seal washers or galvanized steel self-drilling screws compatible with the roof and wall panel finish.

B. All fastener locations shall be as indicated on the manufacturer's erection drawings.

2.07 GUTTERS AND DOWNSPOUTS

A. Manufacturers standard eave gutters and downspouts shall be fabricated from 26 gauge steel with a baked on paint finish to match wall panels.

2.08 SEALANTS AND CLOSURES

A. Polyethylene closed cell closure strips shall be used wherever necessary to insure weather tightness.

B. Roof panel endlaps shall be sealed with a gray elastic compound that equals or exceeds military Specification MIL-C-18969, Type II, Class B.

2.09 ACCESSORIES

A. Accessories supplied by the manufacturer shall include, but not be limited to, the following:

1. Overhang of similar construction as the roof system with soffit panels matching the exterior wall finishes.

2. Sheet metal roof gutters, down spouts and miscellaneous edge flashings with finishes matching the walls.

3. Louvers and gravity dampers shall be provided as specified.

4. Provide manufacturers standard skylights on roof of building as shown on the Drawings.

2.10 FINISHES

A. Color selections will be made by the CITY from the manufacturer's standard colors.

B. Finishes shall be as follows:

1. Structural framing and structural bolts: At the factory, structural framing shall receive one shop coat of primer. At the field, structural framing shall be prepared in accordance with SSPC-SP6 to remove shop primer and provide adequate surface to field paint in accordance with specification Section 09900, "Painting". Structural bolts shall be hot dip galvanized.

2. Wall panels: Zinc aluminum alloy coatings, both sides**,** and painted with a fluoropolymer coating containing 70 percent "Kynar 500".

3. Trims, eaves, gutters, down spouts and accessories: Same type of finish as wall panels. Color will be selected during shop drawing review.

4. Roof panels: Zinc aluminum alloy coatings, both sides.

PART 3 -- EXECUTION

3.01 MEASUREMENT

A. The CONTRACTOR shall verify all dimensions and shall make any field measurements necessary and shall be fully responsible for accuracy and layout of Work. The CONTRACTOR shall review the Drawings and any discrepancies shall be reported to the ENGINEER for clarification prior to starting fabrication.

3.02 FABRICATION

A. Structural steel shall be fabricated in accordance with the Drawings, AISC Specifications, and as indicated on the final reviewed shop drawings.

B. Materials shall be properly marked and match-marked for field assembly.

C. Where finishing is required, assembly shall be completed including bolting and welding of units, before start of finishing operations.

3.03 CONNECTIONS

A. Shop connections shall be welded or bolted as shown. Field connections shall be bolted except where welded connections are specified. All connections, unless shown otherwise

shall develop full strength of members joined and shall conform to AISC standard connections.

3.04 WELDED CONSTRUCTION

A. The CONTRACTOR shall comply with the current AWS D1.1 Code for procedures, appearance, and quality of welds and welders, and methods used in correcting welding work.

B. Unless otherwise shown, all butt and bevel welds shall be complete penetration.

3.05 OPENINGS FOR OTHER WORK

A. Openings shall be provided per AISC Specifications, or as indicated for securing other Work to structural steel framing and for the passage of other Work through steel framing members. Threaded nuts shall be welded to framing, and other specialty items, as shown, to receive the Work. Torch cut holes will not be permitted.

3.06 ERECTION AND INSTALLATION

A. The erection of the building metal frame system shall be performed in accordance with the building manufacturer's erections drawings and instructions. Erection shall be performed by a qualified erector using proper tools and equipment. The building manufacturer shall supply as a minimum a qualified construction advisor during the erection and installation period.

B. Any field modification shall not be made to structural members except as authorized and specified by the building manufacturer.

3.07 SETTING BASES AND BEARING PLATES

A. Prior to the placement of non-shrink grout beneath base and bearing plates, the bottom surface of the plates shall be cleaned of all foreign materials, and concrete and masonry bearing surface shall also be cleaned of all foreign materials and roughened to improve bonding.

B. Loose and attached baseplates and bearing for structural members shall be set on wedges, leveling nuts, or other adjustable devices.

C. Anchor bolts shall be tightened after the supported members have been positioned and plumbed and the non-shrink grout had attained its specified strength.

D. Baseplates shall be grouted with non-shrink grout to assure full uniform bearing. Grouting shall be done prior to placing loads on the structure.

3.08 FIELD ASSEMBLY

A. Structural frames shall be set accurately to the lines and elevations indicated. The various members shall be aligned and adjusted to form a part of a complete frame or structure before being permanently fastened. Bearing surfaces and other surfaces which will be in permanent contact shall be cleaned before assembly. Necessary adjustments to

compensate for discrepancies in elevations and alignments shall be performed, as necessary.

B. Individual members of the structure shall be leveled and plumbed within specified AISC tolerances. The CONTRACTOR shall provide and install all temporary bracing required until structure is complete.

3.09 MISFITS AT BOLTED CONNECTIONS

A. Where misfits in erection bolting are encountered, the ENGINEER shall be immediately notified. The CONTRACTOR shall submit a method to remedy the misfit for review by the ENGINEER. The ENGINEER will determine whether the remedy is acceptable or if the member shall be refabricated.

B. Incorrectly sized or misaligned holes in members shall not be enlarged by burning or by the use of drift pins. The CONTRACTOR shall notify the ENGINEER immediately, and shall submit a proposed method of remedy for review by the ENGINEER. The ENGINEER will determine whether the remedy is acceptable.

3.10 MISFITS AT ANCHOR BOLTS

A. Where misalignment between anchor bolts and bolt holes in steel members are encountered, the ENGINEER shall be immediately notified. The CONTRACTOR shall submit a method to remedy the misalignment for review by the ENGINEER. The ENGINEER will determine whether the remedy is acceptable. The CONTRACTOR shall abide by the ENGINEER's decision.

3.11 GAS CUTTING

A. Gas cutting torches shall not be used in the field for correcting fabrication errors in the structural framing, except when acceptable to the ENGINEER. Gas-cut sections shall be finished equal to a sheared appearance.

3.12 FIELD PAINTING

A. All structural steel shall be field painted after erection per Section 09900.

- END OF SECTION -

SECTION 13253 – PACKAGED MODULAR ODOR CONTROL SCRUBBER SYSTEM

PART 1 – GENERAL

1.01 SCOPE

A. Design, furnish, install, test, adjust, and place in satisfactory operation one (1) low-profile Modular Odor Control Chemical Scrubber (System) at the location shown on the Drawings and as specified herein. The System shall consist of a multi-stage FRP chemical scrubber, exhaust fan, demisters, nozzles, internal media, recirculation pumps, chemical storage tanks, pre-fabricated skid-mounted chemical feed system, exhaust stack, water softener system, control panel, and all necessary instrumentation and accessories required for a complete and operational System.

B. System work covered by this Specification is intended to be standard equipment of proven reliability and as manufactured by reputable Odor Control System Suppliers (OC Supplier). To ensure complete coordination of all components and to provide system responsibility, all equipment furnished under this section shall be the undivided responsibility of the OC Supplier.

C. All equipment located within three (3) feet of the odor control ductwork, odor control system, and exhaust fan, under positive pressure, shall be explosion-proof rated to NEC Class I, Division 2, Group D.

D. All equipment provided, guy wires and fasteners, and associated anchorage and tie-down systems, shall be designed for wind loadingper the latest edition of the Florida Building Code. Wind loading shall be based on a wind speed of 180 MPH, exposure category C.

1.02 OPERATING CONDITIONS AND PERFORMANCE REQUIREMENTS

System	Design Criteria
Quantity of Modular Scrubbers:	1
Air Flow Rate:	1,150 cfm
Average Inlet H_2S Concentration:	500 ppmv
Peak Inlet H_2S Concentration:	1,200 ppmv
Reduced Sulfur Compound Concentration	1.5 ppmv
Minimum Scrubber Removal Efficiency (H_2S and RSCs):	99.5%
Maximum Vessel Footprint:	9.8 ft x 7.33 ft
Scrubber System Pressure Loss, maximum:	8.0 inches w.c.

System	Design Criteria
Ambient Temperature Limits:	30°F to 130°F
No. of Fans:	1
FRP Fan Capacity:	1,150 cfm
FRP Fan Static Pressure:	10.0 inches w.c.
Stage 1 Recirculation Pump Capacity (max):	30 gpm
Stage 2 Recirculation Pump Capacity (max):	30 gpm
Stage 3 Recirculation Pump Capacity (max, if required):	30 gpm
Stage 1 Caustic Metering Pump Capacity:	5 gph
Stage 2 Caustic Metering Pump Capacity:	5 gph
Stage 2 Hypochlorite Metering Pump Capacity:	50 gph
Minimum Metering Pump Discharge Pressure:	50 psi

1.03 RELATED WORK SPECIFIED ELSEWHERE

A. DIVISION 01 – APPLICABLE SECTIONS

B. SECTION 09900 – PAINTING

C. SECTION 11000 – EQUIPMENT GENERAL PROVISIONS

D. SECTION 13252 – FRP DUCTWORK

E. SECTION 15000 – BASIC MECHANICAL REQUIREMENTS

F. DIVISION 16 – APPLICABLE SECTIONS

G. DIVISION 17 – APPLICABLE SECTIONS

1.04 SUBMITTALS

A. Submit the following information 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. List of at least five similar installations of the System type, capacity, odor loading, and location conditions being proposed, including date installed, contact name, address and phone number.

2. Dimensioned drawings of entire System specific to the proposed site and including all components, showing assemblies, arrangements, piping, valves, sizes of field connections and controls. Include operating and dry weights.

3. Dimensioned drawings of pre-fabricated, skid-mounted chemical feed system specific to the proposed site, showing assemblies, metering pumps, arrangements, piping, valves, and all accessories.

4. Dimensions of each chemical storage tank, and dimensions, location, and orientation of openings, fittings, accessories, attachments, restraints and supports, manways, and flexible connections specific to the proposed site.

5. Submit color chart describing the available colors for the vessel exterior pigment color to be selected by the Owner.

6. Materials of construction for all equipment including FRP equipment resin and interior coating descriptions for equipment interior surfaces.

7. Certified performance characteristics for both air and chemical performance of the equipment being provided. List air pressure drop and chemical consumption at specified design conditions.

8. The media supplier shall submit actual operating data from previous installations to substantiate performance claims, specifically: pressure drop, liquid holdup, flooding points, and mass transfer rate (HTU or KGA).

9. Calculations verifying sizing of recirculation pumps, chemical metering pumps, pump performance, chemical storage tanks, and equipment data.

10. Complete motor nameplate data as defined by NEMA.

11. Complete instrumentation, control, logic, and power wiring diagrams. Instrumentation and control component data. Control panel front and rear panel layouts.

12. Certification from OC Supplier of applicable wind load design for vessel and chemical tanks in accordance with current edition of the Florida Building Code.

13. Complete design calculations for the FRP vessel, signed and sealed by a Registered Professional Engineer in the State of Florida.

14. Anchor and tie-down system design calculations for the vessel, fasteners for exhaust stack guy wire system, and chemical tanks, signed and sealed by a Registered Professional Engineer in the State of Florida. Shall include, but not be limited to, anchor calculations for design of fastening tanks and System to concrete pad to withstand applicable wind load criteria and other loadings discussed herein, such as tank flotation. Shall include size, embedment, and

installation design criteria for anchor bolts, tie downs, and exhaust stack guy wire system.

15. Written instructions as to the recommended methods for unloading, storing, and installing the fiberglass vessel and chemical storage tanks and recommended lifting and handling procedures.

16. Complete handling, storage, installation, and adjustment instructions and recommendations.

17. Performance Affidavit, Guarantee, and Warranty.

18. Performance testing procedures and results.

19. Detailed instructions for pipe connections and bolt torque values.

20. Chemical storage tank wall thickness calculations per ASTM D 1998 using 600 psi design hoop stress @ 100°F.

21. A complete manufacturer's specification of the resin used for chemical storage tanks provided.

22. Factory test report for chemical tanks provided, including wall thickness verification, fitting placement verification, visual inspection, impact test, gel test, and hydrostatic test.

23. Statement that materials, resin, and fittings used for the chemical tanks are suitable for intended service.

24. List of recommended spare parts.

25. The following motor data shall be provided:

    a. Name and manufacturer
    b. Type and model
    c. Bearing type and lubrication
    d. Horsepower rating and service factor
    e. Temperature rating
    f. Full load rotative speed
    g. Net weight
    h. Efficiency at rated load
    i. Full load current
    j. Overall dimensions

26. In addition, submit the following data for all recirculation pumps provided:
    a. Name of manufacturer.
    b. Type and model.
    c. Rotative speed.
    d. Size of suction and discharge nozzles.

e. Net weight of pump only.
f. Net weight of baseplate and couplings.
g. Performance curves showing capacity versus head, net positive suction head (NPSH) required, efficiency, and brake horsepower (BHP).

B. Operation and Maintenance Manuals in accordance with 01300, Submittals.

1. In addition to the normal Installation, Operation and Maintenance Manuals required by contract, a spare manual shall be shipped with the unit in order to allow for proper operation of equipment prior to release of all final Installation, Operation and Maintenance Manuals to the end user.

2. Operation and Maintenance Manuals shall each include fully commented and cross-referenced printouts of the final program and printouts of the Operator Interface screens, showing the functionality of each object on the screens.

C. OC Supplier's report of satisfactory installation and field operational tests.

D. Certificate of Conformance as required under Quality Assurance.

1.05 QUALITY ASSURANCE

A. OC Supplier's Qualifications: The work covered by this Specification is intended to be standard equipment of proven reliability and as manufactured by reputable manufacturers having a minimum of ten (10) years of experience in the production of packaged, low-profile odor control chemical scrubbers. The equipment furnished is to be designed, constructed, and installed in accordance as shown on the Contract Drawings and operated per OC Supplier's recommendations. The OC Supplier shall show evidence of at least five (5) similar design installations of the capacity of 1,000 cfm or larger, and with H_2S inlet concentrations greater than 500 ppm, in satisfactory operation in wastewater treatment plants or wastewater pumping stations for at least 3 years. Provide Owner's name, project location, and contact information.

B. The Contractor is responsible for the successful startup and testing of the System. Provide all necessary facilities, manpower, chemicals, tools, instrumentation, and laboratory testing services required to properly install, adjust, and place in operation a working system.

C. OC Supplier's Certifications: Certificate of Conformance: Furnish a notarized letter/certificate, signed by a corporate officer of the OC Supplier, stating that the design of the equipment meets the design and operating criteria specified in paragraph 1.02 and will meet the performance requirements specified in paragraph 1.02. Shop drawings will not be reviewed unless accompanied by the Certificate of Conformance.

D. NEMA Compliance: Motors and electrical accessories to comply with NEMA standards.

E. Electrical Component Standard: Components and installation to comply with NFPA 70 “National Electrical Code”.

1.06 OC SUPPLIER’S RESPONSIBILITY

A. The OC Supplier shall be responsible for coordination of the design and fabrication of the odor control System specified herein and as shown on the Drawings.

B. The OC Supplier shall coordinate and review installation procedures under other Sections and coordinate the installation of items that must be installed to comply with the requirements of the Work specified under this Section.

C. Provide the services of a qualified manufacturer’s technical representative in accordance with Section 01650 – Equipment Testing and Plant Startup and Section 11000 – Equipment General Provisions. Field services shall include the following site visits:

1. At least one (1) trip of four (4) days to check and supervise the installation of the System (including the media), supervise functional testing, supervise initial startup and operation, and instruct the City’s personnel in proper operation and maintenance of the equipment. Training session shall include both classroom and field training.

2. At least one (1) trip of two (2) days for performance testing, in addition to the start-up, functional testing, and training trip.

D. Any additional time required to achieve successful installation and operation shall be at the expense of the Contractor.

E. A written report covering the representative’s findings and installation approval shall be provided directly to the Engineer covering all inspection and outlining in detail any deficiencies noted. Written report shall state that the System has been properly installed and tested to the OC Supplier’s satisfaction and that all required final adjustments have been made.

F. The times specified exclude travel time to and from the facility and shall not be construed as to relieve the OC Supplier of any additional visits to provide sufficient service to place the equipment in satisfactory operation.

G. The OC Supplier and the Contractor shall be responsible for any license fees that may apply to this system.

1.07 WARRANTY

A. The odor control vessel, media, and media support system shall be warranted for a period of ten (10) years from final acceptance.

B. All System components shall be warranted free of manufacturing defects for a period of 12 months from Substantial Completion, or 18 months from equipment delivery to site, whichever occurs first.

PART 2 – MATERIALS

2.01 ACCEPTABLE OC SUPPLIERS

A. Subject to compliance with the requirements of this Section, the following OC Suppliers have the capability of manufacturing the work in this Section:

1. Evoqua Water Technologies.

2. ECS Environmental Solutions.

3. Or Approved Equal.

B. The naming of an OC Supplier in this Section is not an indication that the OC Supplier's standard equipment is acceptable in lieu of the requirements of this specification. Naming is only an indication that the OC Supplier may have the capability of engineering and supplying a system as specified. System shall adhere to the requirements of this specification.

2.02 OVERALL SYSTEM REQUIREMENTS

A. The System is to consist of a complete pre-piped, pre-wired, and packaged construction System including an integral absorber with a minimum of two (2) separate packed bed counter-current scrubbing stages – each with its own sump, mist eliminator, and recirculation pump – three (3) chemical metering pumps, fan, chemical storage tanks, water softener system, piping, valves, fittings, ductwork, control panel, and all other equipment, instrumentation, and accessories as specified to provide a complete and functioning system.

B. General Process Description:

1. Foul air enters the system at the bottom of the first stage (counter current) of the scrubber. Scrubbing solution is sprayed onto the top of the packing to create a large liquid-gas interface surface area. The odor-causing components are absorbed by the scrubbing liquid.

2. The air passes through a mist eliminator, exits the first stage and passes through an internal duct baffle to the bottom of the second stage. Scrubbing solution is sprayed on top of the media in the second stage.

3. If required, the air passes through a third stage and scrubbing solution is recirculated to the top of the media in the third stage.

4. The treated, odor-free air exits the scrubber after passing through a final mist eliminator.

5. Scrubbing solution accumulates in a sump at the bottom of each stage to be recycled through the scrubber packing. A small amount of the scrubbing solution is wasted through the overflow connection in the sump. The amount of scrubber liquid wasted is controlled by adding water to each sump at a continuous rate.

C. All wetted parts must be corrosion resistant to the recirculation scrubbing liquid.

D. No metallic wetted parts are allowed except for internal bolting constructed of Hastelloy C unless otherwise indicated.

E. Unless otherwise specified, all fasteners and metal attachments, such as anchors, brackets, etc. shall be 316 SST.

F. The sizes and capacities of the equipment components listed herein establish minimum requirements only – manufacturer is responsible for verifying sizing for the system furnished to meet the design criteria.

G. All equipment shall be furnished with motors such that the motor shall not be overloaded throughout the full range of operation, unless otherwise specifically approved by the Engineer.

H. The 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 related electrical equipment (conduit, wires, starters, etc.) at no additional cost to the City.

2.03 MODULAR ODOR CONTROL SCRUBBER

A. General: The System is to be a multi-stage, once through packaged chemical absorber. The System is to consist of at least two vertical counter-current gas absorption sections. The packed bed sections are to include a spray header to distribute the liquid evenly over the packing. The treated airflow is to pass through a high efficiency mist eliminator prior to discharge from each stage. The System is to be equipped with a minimum of two self-contained sumps.

1. Scrubber orientation and interconnecting ductwork shall be as shown on the Drawings.

2. Provide access manways in the scrubber to allow access to the internals. At a minimum, provide access manways at the top and bottom of the packing sections, chemical sumps, and the mist eliminator area.

3. The system is to include all piping, valves, and internals. The materials of construction of the internal components are to be as follows:

Packing Media Support:	Vinyl Ester FRP grating
Packing Media:	Polypropylene
Liquid Distributor:	PVC
Spray Nozzles:	Polypropylene
Mist Eliminator:	Polypropylene

4. Recirculation pumps shall be mounted on the Scrubber vessel. The System is to be pre-piped, pre-wired, and shipped as a single unit. Control panel and chemical metering pumps shall be mounted as shown on the Drawings.

B. All equipment is to conform to applicable sections of the following standards except where otherwise specified herein.

1. NBS PS 15-69 – National Bureau of Standards Voluntary Product Standard "Custom Contact Molded Reinforced Polyester Chemical Resistant Process Equipment".

2. ASTM D883 – "Definition of Terms Relating to Plastics"

3. ASTM D2583 – "Test for Indentation Hardness of Rigid Plastics by Means of Barcol Impressor."

4. ASTM D2563 – "Recommended Practice for Classifying Visual Defects in Glass Reinforced Plastic Laminate Parts."

5. ASTM D4097-01 (2010) – "Standard Specifications for Contact Molded Glass Fiber Reinforced Thermoset Resin Corrosion Resistant Tanks."

6. ASTM C582-09 – "Standard Specifications for Contact Molded Reinforced Thermosetting Plastic (RTP) Laminates for Corrosion-Resistant Equipment."

C. Materials of Construction:

1. The scrubber absorber vessel and accessories shall be contact molded manufactured in accordance with NBS PS 15-69, ASTM D 4097 for contact molding.

2. Any visual defects shall be better than Level II on the inside and outside of the vessel in accordance with ASTM D2563.

3. Any material of construction other than FRP with premium grade vinyl ester resin will not be allowed.

4. Vessel wall thickness shall be as required by structural design but not less than ¼ inch.

5. Reinforcement: Glass fiber reinforcement used shall be commercial grade corrosion resistance borosilicate glass.

    a. All glass fiber reinforcement shall be Type C chemical grade, Type E electrical grade.

    b. Surfacing veil shall be 10 mil Nexus 111-00010 or equal.

    c. Mat shall be Type "E" (electrical grade) glass, 1 1/2 oz. per sq. ft with a nominal fiber length of 1.25 $\pm$ 0.25 inches, with a silane finish and styrene soluble binder.

    d. Continuous glass roving, used in chopper gun spray-up applications shall be type "E" grade with chrome or silane coupling agent.

    e. Woven roving used for reinforcement shall be 24 oz. per sq. yard type "E" glass and have a 5 x 4 plain weave.

6. Miscellaneous:

    a. Stainless Steel: Unless otherwise specified, all fasteners, and metal attachments, such as anchors, brackets etc shall be ANSI 316SS.

    b. Gaskets: Unless otherwise specified, all gaskets shall be full-face, 1/8-inch thick, EPDM gaskets of 60 durometer.

D. Fabrication:

1. General: Fabrication shall be in accordance with NBS PS 15-69 and ASTM D-4097. All non-molded surfaces shall be coated with resin incorporating paraffin to facilitate a full cure of the surface. The resin used in the corrosion barrier and structure layers shall be a premium vinyl ester type, fire-retardant with Class 1 flame spread rating, such as Hetron™ FR922 or Derakane™ 510A as manufactured by Ashland Composites, a subsidiary of INEOS; Vipel® F010 as manufactured by AOC Resins; or pre-approved equal. The resin shall be suitable to exposure of hydrogen sulfide fumes at the design concentrations. All cut edges, bolt holes, secondary bonds shall be sealed with a resin coat prior to the final paraffinated resin coat. All voids to be filled with a resin paste.

2. Corrosion Liner: The inner surface of all laminates shall be resin rich and reinforced with NEXUS 111-00010 with a minimum thickness of 10 mils. The interior corrosion

layer shall consist of two layers of 1 1/2 oz. per sq. ft. chopped strand mat. If the application is by chopper gun spray up the glass fiber shall be 1/2 to 2 in length. The total corrosion liner thickness shall be a minimum of 100 mils and have a resin to glass ratio of 80/20. All edges of reinforcement to be lapped a minimum of one inch. Corrosion liner shall be cured using BPO/DMA technique.

3. Structural Laminate: Structural laminates shall consist of alternating layers of 1-1/2 oz per sq. ft mat or chopped glass and 24 oz per sq. yard woven roving applied to reach a minimum 100-mil thick corrosion barrier. Actual laminate sequences shall be per the laminate tables shown on fabrication drawings. The exterior surface shall be relatively smooth and shall have no glass fibers exposed. The exterior shall be surface coated with white gel coat containing ultraviolet light inhibitors.

4. All cut edges, bolt holes, secondary bonds shall be sealed with a resin coat prior to the final paraffinated resin coat. All voids to be filled with a resin paste. No thixotropic or other additives shall be used.

5. Vessel components shall be preassembled at the point of fabrication. Preassembly will not require all joints to be factory assembled, but all joints shall be prepared for field fabrication and square within plus or minus 3/16 inch. Each matched piece shall then be numbered correspondingly.

E. Accessories:

1. Air inlet, air exhaust, pump connections, spray headers, baffles, packing support, drain, level connections, access for mist eliminator and all connections shown on the drawings, or required, shall be provided by the OC Supplier.

2. Tie-Down Lugs: Integrally molded into the walls of the sump.

3. Anchor Bolts: 316 SST and designed for the specified loads.

4. Flanges:

   a. Liquid Service: Per ANSI Std B 16.9

   b. Air Ducts: Duct flanges per PS 15-69 Table 2.

   c. Access Flanges for manways, mist eliminator, and packing access are to be air-tight to the pressure equal to or higher than the corresponding fan static pressure and water-tight.

5. Fasteners attached to the vessel top/corners for attachment to a stabilizing guy wire system to support discharge stack, deigned to meet the Florida Building Code and as required by OC Supplier’s design calculations.

6. Interior Fasteners: Corrosion resistance materials such as FRP.

F. Mist Eliminator: Provide a high efficiency, chevron-type mist eliminator at the discharge of each scrubbing stage. The mist eliminator is to remove 99% of all mist particles 40 microns and larger and 90% of all mist particles 10 microns and larger.

G. Mist Eliminator Wash System: Provide a liquid distributor system with nozzles and isolation valve to manually spray dilute hydrochloric acid for mist eliminator and packing washing for each stage.

H. Shipping: Except for the fan, inlet transition, exhaust stack, and the connection of the stages, design, fabricate, factory assemble and ship the System to the job site as a single piece or a single skid-mounted unit.

I. Piping: All chemical, recycle, make-up water, drain and blowdown piping is to be SCH 80 CPVC.

J. Neoprene Pad: Provide a 1/4” thick, 60 durometer neoprene rubber sheet to be placed underneath the scrubber vessel.

K. Scrubbing Liquid Distribution Header: The header shall be made of Schedule 80 CPVC or FRP and be of the manufacturer's design. Nozzles and material shall be suitable for the use with the recirculation liquid (including non-potable water). Nozzles shall be non-clog, single piece design. The header shall be located above the packing and shall consist of a uniformly distributed full bed diameter single spray, with no moving parts. Multiple spray systems with pipe lateral type distributors located above the packing will also be acceptable. The distributor piping shall be constructed with screwed connections capable of disassembly. Spray nozzles shall be easily removable from the exterior of the tank for cleaning.

L. Exhaust Stack: Manufactured of FRP and provided to the elevation shown on the Drawings with a high-velocity discharge nozzle. Stabilizing guy wires shall be provided to support discharge stack with fasteners attached to the vessel top/corners, as required by OC Supplier’s design calculations. The stack shall include an integral transition from the scrubber outlet rectangular flange to the round duct. The exhaust shall be manufactured similar to the vessel as described in Parts 2.03.C and 2.03.D.

M. Packing Support: Provide fiberglass grating suitable for supporting scrubber packing under all conditions of operation, including a flooded bed condition. Permanently attach grating or grating support to the scrubber wall by lapping with fiberglass and resin. Coat any cut fiberglass edges with the same premium resin used for the FRP supports. No bolting or metal fasteners will be allowed. Packing support open area is to be greater than 80 percent of the total cross section.

N. Packing:

1. Type: Non-clogging, non-nesting type, capable of being dumped onto the scrubber grating without causing physical damage. Provide sufficient packing to fill the bed

to a depth within ±2” of the design after 90 percent of expected settling has occurred.

2. Material: Polypropylene

3. Size: 3.5” or 4.0” diameter.

4. Maximum Pressure Drop: 0.20 inches of water column per foot of packing.

5. Manufacturer: Tri-Packs as manufactured by Jaeger, Inc., Lantec Lanpac XL, or equal.

2.04 FIBERGLASS REINFORCED PLASTIC (FRP) FANS

A. Provide fire-retardant, radial fume exhauster-type fans composed of FRP with an epoxy or UV gel coating to protect against ultraviolet degradation. Fans shall be installed complete with motors, drives, guards, and coatings of sufficient capacity for the duty required. Fans shall operate to draw odorous air from the process areas shown and shall exhaust air through the System.

1. The fans shall use a V-belt drive, arrangement as shown, equipped with a slip inlet, drilled outlet flange, Teflon shaft seal, 316 SST shaft, fan guard, and motor enclosure.

2. Fans shall be factory-fabricated and assembled, factory-tested, and factory-finished with indicated capacities and characteristics.

3. Basis of fan performance shall be at standard conditions (density of 0.075 lb/ft3).

4. Selected fans shall be capable of accommodating static pressure and flow variations of +/-15% of scheduled values.

5. Fans shall be equipped with lifting lugs.

6. Nameplate: Each fan shall be furnished with a permanently affixed Type 316 stainless steel nameplate with manufacturer’s name, model number, serial number, and electrical data.

7. Mounting: The entire fan and motor assembly shall be mounted on vibration isolators to reduce noise transmission.

8. Rotating Assembly: Rotating assembly shall be statically and dynamically balanced to balance grade G6.3 per ANSI S2.19 and designed for continuous operation at the maximum rated fan speed and motor horsepower.

B. Fan shall be constructed such that all surfaces in contact with the corrosive gas stream are made of solid, corrosion-resistant FRP. All nuts, bolts, and fasteners in contact with the gas stream shall be Type 316 stainless steel and encapsulated in FRP.

C. Manufacturer: Manufactured by The New York Blower Company, Hartzell, or Ceilcote/Verantis.

D. Performance: Fan ratings shall be based on tests made in accordance with AMCA Standard 210. Fans shall be licensed to bear the AMCA Certified Ratings Seal for Air Performance. Fans not licensed to bear the AMCA Seal for performance shall be tested, at supplier's expense, in an AMCA Registered Laboratory. Fans shall have a sharply rising pressure characteristic extending throughout the operating range to assure quiet and stable operation. Fan speed and motor size shall be selected by the OC Supplier to meet the required conditions of air flow rate and pressure drop across the biological odor control System and ducting, including the pressure drop in the ducting upstream of the biological odor control System inlet. Fan speed shall not exceed 85% of the maximum allowable driven speed of the fan.

E. Motor: Motor shall be selected by fan manufacturer and designed to meet the requirements listed in Paragraph 1.02. Provide motor with an adjustable base for varying belt tension and belt alignment. Motor shall meet the requirements specified in the table below.

	Exhaust Fan
Rating	480V, 3 ph, 60 Hz
Horsepower (max)	5.0
Speed, max rpm	1,800
Enclosure	TEFC, Suitable for Class I, Div 2 Environment
Insulation	Class H
Inverter Duty	No
Service Factor	1.15
Space Heater	No
Motor Winding Temperature Switches	No
Drive	Constant

F. Sound: Fan manufacturer shall provide sound power level ratings for fans tested and rated in accordance with AMCA Standards 300 and 301. Sound power ratings shall be in decibels (reference IOE-12 watts) in eight (8)-octave bands.

G. Bearings: Bearings shall be grease-lubricated, precision anti-friction ball, self-aligning, pillow block design. Bearings shall be designed for a minimum L10 life of 30,000 hours

(150,000 hours L50 life) when rated at the fan's maximum cataloged operating speed. Fan bearings shall be visible and accessible for inspection and maintenance. Bearings enclosed within the fan housing where they can be exposed to the corrosive gas stream are not acceptable.

H. Construction: Fan shall be constructed in accordance with the ASTM D-4167 standard specification for FRP fans and blowers to ensure structural integrity. All surfaces exposed to the atmosphere shall be rich in paraffinated resin, shall be stabilized against ultraviolet degradation, and shall include a reinforcement not to exceed 20% “C” grade fiberglass. All parts exposed to the foul air stream shall be constructed of, or encapsulated in, an FRP laminate capable of resisting continuous airstream temperatures of 250 degrees Fahrenheit. All resins shall be clear to allow detection of subsurface imperfections. Use of pigments, gel coats, inhibitors, and additives which may disguise flaws in the laminate is prohibited.

1. Housing: Fan housing shall be constructed of a fire-retardant polyester resin or Type II PVC with an ASTM E84 Class I rating. Housing laminate construction shall conform to ASTM Standard C-582. Airstream surfaces shall be smooth to minimize resistance and prevent buildup of airborne contaminants. Shaft hole openings shall be fitted with a Teflon closure having a maximum clearance of 1/32-inch to minimize leakage. A flanged inlet and flanged outlet composed of FRP construction shall be furnished on the fan. Inlet assembly shall be bolted to permit wheel removal. Fan shall be furnished with an access door, positioned to avoid collection of condensation, and a 1-inch minimum flanged type drain connection, positioned at the lowest portion of the fan scroll.

2. Wheel: Wheel shall be backwardly-inclined, single thickness type. Wheel blades shall be airfoil-type blades, which limit load horsepower characteristics so the motor provided with each fan does not exceed the maximum design motor horsepower. Non-overloading design for increased efficiency. Wheel shall be fabricated of a fire-retardant vinyl ester resin with an A8TM E84 Class II rating no greater than 30. Wheel hub shall be permanently bonded to the shaft and completely encapsulated in FRP to ensure corrosion resistant integrity. Steel wheels coated with FRP or wheels with taper-lock hubs are not acceptable.

3. Shaft: Shaft shall be Type 316 stainless steel, with an FRP sleeve fixed securely and bonded to the wheel backplate. The sleeve shall extend out through the housing shaft hole for corrosion protection. The shaft first critical speed shall be at least 125% of the fan's maximum operating speed. Shaft shall be counter-sunk for tachometer readings.

I. Belt Drives:

1. Belt drive components shall be sized based on a service factor of 1.4.

2. Pulleys shall be of the fully-machined cast iron-type and shall be keyed and securely attached to the wheel and motor shafts. Motor pulleys shall be adjustable for final balancing.

3. Belts: Oil-resistant, non-sparking, and non-static.

4. Belt drives shall be factory-mounted with final alignment and belt adjustment made after installation.

5. Belt Guard: Provide an OSHA-compliant belt guard composed of FRP on the outside of the fan cabinet. Belt guard or motor cover shall to completely cover the motor pulley and belt(s).

J. Balance and Run Test: The wheel and shaft shall be dynamically balanced on precision balancers. Prior to shipment, completed fans shall receive a final test balance at the specified operating speed.

K. Final Inspection: All fans shall receive a final inspection by a qualified inspector prior to shipment. Inspection shall include fan description and accessories, balance, welding, dimensions, bearings, duct and base connection points, paint finish, and overall workmanship.

L. The fan and motors shall be factory-mounted on a structural channel subbase with integral motor slide base.

M. Expansion joints shall be provided at the fan inlet and exhaust connections. Expansion joints shall be in accordance with Section 13252, FRP Ductwork.

2.05 RECIRCULATION PUMPS

A. A recirculation pump shall be provided for each sump. Operating Conditions and Performance Requirements for Recirculation Pumps shall be as described in Paragraph 1.02 above.B. The recirculation pump shall be a seal-less, rugged, vertical, centrifugal type pump of CPVC, polypropylene or BPO/DMA cured fiberglass construction for corrosion resistance and long service life. No seal water shall be required. The pump shall be suitable for solutions with a pH of 14. Recirculation pumps shall be Vanton SUMP-GARD SGK, Fybroc 7500 Series, or equal.

C. Pump shall have a stainless steel one-piece rotor drive shaft covered with a one-piece CPVC, polypropylene or FRP sleeve and impeller. There shall be no liquid to metal contact, no seals, no pump bearings, bushings or wearing parts. The pump shall be mounted for easy service on the scrubber system sump.

D. Pump impeller shall be located in the submerged casing. Pump shall be provided with cantilevered shaft, no bearings immersed in the process fluid and dry running capability.

E. All units shall be statically and dynamically balanced throughout, and an analysis of the pump and motor shall be performed to ensure that there are no frequencies of vibration that form harmonic resonance between them as a unit in operation. The vibration allowance in the units shall not exceed 4 mils at any point on the unit while running

within 15 percent above or below the design point on the curve using the head or gpm for which the units have been designed to function.

F. Radial and thrust ball bearings shall be provided, which shall safely carry all radial and thrust loads. The bearings shall be of the antifriction, grease or oil lubricated, ball or roller type in a dustproof housing. The bearing frame shall be of rigid construction to support the shaft. Bearings shall have an ABMA L10 life of 100,000 hours.

G. A non-metallic vapor seal shall be provided to protect the metal motor bracket from corrosive fumes.

H. Recirculation pump capacities and motor horsepower shall be as specified herein and verified by the OC Supplier for proper flow rate and pressure as required for installation. Pump sizing calculations shall be submitted to the Engineer for review.

I. The pump shall be furnished with an all plastic fabricated strainer basket with ¼" diameter perforations in same to keep any large particles out of the casing or impeller area.

J. Motors shall be manufactured by WEG, Siemens, Tatung, or approved equal. Motors shall meet the following requirements:

Rating	480V, 3 ph, 60 Hz
Maximum Horsepower	2.0
Speed, rpm	1,800
Enclosure	TEFC (Class 1, Div 2)
Insulation	Class F
Inverter Duty	No
Service Factor	1.15
Space Heater	No
Motor Winding Temperature Switches	No

2.06 CHEMICAL FEED SYSTEM

A. The chemical feed system is to be designed for 50% sodium hydroxide and 12.5% sodium hypochlorite and is to dilute and deliver the chemical solution from the chemical storage tanks to the spray nozzles where it is circulated through the packing media.

B. Provide a pre-fabricated, skid-mounted chemical feed system. The chemical feed system shall contain all piping and equipment necessary to deliver chemicals from sodium hypochlorite and sodium hydroxide storage tanks to the scrubber vessel.

C. Skid manufacturers shall be Blue Planet Environmental Systems, Inc., Prominent or equal.

D. The Contractor shall be responsible for the following:

1. Providing and installing required interconnecting piping between the storage tanks and the skid-mounted chemical feed system and from the skid-mounted chemical feed system to the chemical scrubber.

2. Providing and installing the wiring between the pumps and the system control panel.

E. Chemical Metering Pumps:

1. Chemical metering pumps shall meet the Operating Conditions and Performance Requirements provided in Paragraph 1.02 above and shall be suitable for continuous, 24 hour per day, 365 day per year operation.

2. Metering pumps shall be positive displacement, non-lost motion, mechanical diaphragm type, Wallace and Tiernan model Encore 700 series, or equal model as manufactured by Prominent, Pulsafeeder, or Milton Roy.

3. Motors for the chemical feed pumps are to be brush type, permanent magnet, constant torque, DC motors with the following features:

a. Enclosure: TENV, corrosive duty, suitable for Class I, Division 2 environment

b. Insulation: Class H insulation with Class B temperature rise, 40C ambient.

c. Permanently lubricated double shielded ball bearings.

d. Motors 1.0 HP and below shall be rated for continuous duty at 90 VDC. Motors larger than 1.0 HP shall be rated for continuous duty at 180 VDC.

e. Motors shall be sized so that at no time during any operating condition shall the torque required by the pump exceed that available continuously from the motor.

f. Stroke frequency shall be controlled through speed adjustment of the variable speed, constant torque, DC motor drive. The SCR Control Unit controlling the motor speed shall consist of an electronic switching amplifier, SCR full wave rectifier and associated circuitry; specifically designed for use with constant torque motors. Closed loop speed regulation through a feedback tachometer input shall provide feed rate control accurate to ±0.1% of full scale. SCR control unit shall be remote mounted.

4. The stroke frequency adjust mechanism, driven by a direct coupled, SCR drive DC motor, shall actuate a convex-shaped or flat, teflon-faced composite diaphragm. Solenoid driven pumps will not be accepted.

5. Stroke length shall be controlled manually via a 10-turn micrometer-type adjuster. A percent scale and vernier shall indicate stroke length in 0.25% increments. Each revolution of the knob shall change stroke length by 10%.

6. The OC Supplier is responsible for the coordination of corrosion resistant materials for the chemical solutions specified. The OC Supplier shall include all features as necessary for satisfactory operation of the pumping systems for chemical solutions specified. Pumps, motors, and accessories shall be coated with a heavy duty protective epoxy coating resistant to the specified chemical to prevent corrosion.

7. The metering pumps shall be provided with an oil-lubricated gear reducer and cam-and-spring drive mounted in an aluminum or epoxy-painted cast iron housing. The housing shall be sealed into an outer plastic housing for corrosion protection with heat sink fins for cooling.

8. The liquid ends shall include cartridge-type ball check valves. Conventional threaded valves will not be allowed. Valve service or removal shall not require any disturbances to the pump head pipeworks.

9. The liquid end shall be physically separated from the drive unit by a back plate with weep hole creating an air gap. An elastomer shaft wiper seal or secondary diaphragm shall prevent contamination of the gear box if the primary diaphragm fails.

10. The pump and motor shall be mounted on a common base. The motor shall be direct coupled to the gear box.

11. Each pump and motor shall have a corrosion resistant nameplate giving the manufacturer's model, serial number, rating, range, speed, and other pertinent data.

12. SCR drives shall be located in the System control panel.

13. Acceptable materials of construction shall be as follows:

	Sodium Hydroxide [Caustic] (50%)	**Sodium Hypochlorite [Hypo] (12.5%)**
Diaphragm	PTFE faced EPDM with Steel Core	PTFE faced EPDM with Steel Core
Housing Material	Glass-filled Luranyl	Glass-filled Luranyl
Liquid End Material	PVC	Kynar
Ball Check Valve	PVDF with PTFE faced Viton Gasket Seals	PVDF with PTFE faced Viton Gasket Seals

	Sodium Hydroxide [Caustic] (50%)	Sodium Hypochlorite [Hypo] (12.5%)
Ball Check Valve Balls	Ceramic	Ceramic
O-Ring Seals	Teflon (PCTFE), Hypalon, Buna-N	Teflon (PCTFE), Viton
Hardware	316 SS	Hastelloy C or Titanium

F. Metering Pump Skid Assembly:

1. All metering pump accessories shall be provided by the metering pump manufacturer and installed on a pre-fabricated skid which houses both the sodium hypochlorite and the sodium hydroxide chemical metering pumps.

2. Each pump shall have the ability to function as an isolated pump (i.e., independent of piping and operation of the other pumps mounted on the skid assembly).

3. Pumps shall be provided as skid mounted chemical metering pump systems complete with the skid assembly containing chemical metering pumps, all necessary piping, valves, fittings, supports, electrical controls, and accessories as specified herein. The metering pump skid shall contain the following items:

    1. Metering pumps – all 120 V / 1 phase
    2. Calibration columns
    3. Pulsation dampeners (discharge)
    4. Pressure gauges (indicators) with diaphragm seals
    5. Isolation valves
    6. Pressure relief valves
    7. Backpressure valve
    8. Suction side strainers
    9. Flushing connections with isolation ball valves on both suction and discharge side piping

    12. Power and Signal wiring pre-wired junction box

4. All piping, valves, gaskets, supports, hardware, wiring, junction boxes, and accessories necessary for a fully functioning skid. Piping shall be terminated within 2 inches from the edge of skid. All piping within the skid shall be installed with a minimum of 3 inches spacing between all fittings to facilitate repairs. Sodium hypochlorite skid piping shall be built with an inverted suction manifold. Electrical cables shall terminate in the pre-wired termination panel.

5. The chemical feed system shall be completely assembled by the Skid Manufacturer, mounted, calibrated, tested, and delivered to the site on a single

skid. Components to be mounted on the skid shall include, but not be limited to, the metering pumps, calibration column, piping, valves, piping accessories (pulsation dampeners, etc.), and wiring integral to the skid. The Skid Manufacturer shall be responsible for providing all equipment, valves and piping within the skid boundary

6. The skid shall be constructed of a material that is corrosion resistant to the chemical service as recommended by the skid manufacturer and suitable for long term service. The skid shall have adequate supports for all equipment and piping. Anchor bolt holes shall be provided. The skid should be of an open style with a removable front splash shield. The skid shall be suitable to be mounted on top of an FRP grating table.

7. Accessories shall be connected to piping with flanged ends (not threaded).

8. Pressure gauges: See Paragraph 2.13, Item F.8 for details. Gauges shall be provided on the discharge of metering pumps. Each gauge shall have a range of zero to 100 psi. Each gauge shall be provided with a diaphragm seal, constructed of materials which are completely resistant to corrosion by the chemicals referred to in this Section. Each pressure gauge shall also be provided with an isolation valve. Isolation valves shall be PVC with seals that are resistant to the chemical applications.

9. Pressure Relief Valves:

    a. Provide pressure relief valves in the discharge piping.

    b. Pressure relief valve body shall be constructed of PVC or other material resistant to the process chemicals and compatible with the operating pressures. Diaphragm shall be of Hypalon/PTFE construction.

    c. Pressure relief valves shall have a built-in priming valve, fully adjustable setting via external screw, and piping connections of a size as to accommodate the pump discharge piping.

    d. The valve shall be set at a relief pressure that is 90 percent of the maximum design discharge pressure.

    e. Sizing of the valves shall be the responsibility of the OC Supplier and calculations shall be submitted with Shop Drawings.

10. Antisiphon / back pressure valves: Valves shall be manufactured by the pump manufacturer and shall be completely resistant to the chemicals for which they are provided. Sizing of the valves shall be the responsibility of the manufacturer and calculations shall be submitted with Shop Drawings.

11. Pulsation Dampeners: Diaphragm and body materials and configuration shall be supplied for the specific chemical for which the dampener is used without corrosion, wear, or other cause of abnormally short life. Each dampener shall be equipped with a charging valve and gas pad pressure gauge rated at 0 to 150 psi. Sizing of the pulsation dampeners shall be the responsibility of the manufacturer, and calculations shall be submitted with Shop Drawings.

12. Calibration Columns:

    a. Provide calibration columns in the suction piping. Each calibration column shall be furnished with a valve and schedule 80 PVC or CPVC (as applicable) nipple for connection to the suction piping.

    b. The capacities of the calibration columns shall be 2,000 cc.

13. Skid pipe shall be CPVC Schedule 80. CPVC shall be Class 23447-B or better, conforming to specification ASTM D1784 and ASTM F441/F441M. Cement shall be as recommended by the pipe manufacturer for the service outlined in this Section.

14. Vented ball valves shall be utilized for sodium hypochlorite service. The valves supplied under this specification shall meet the requirements of the Section entitled “Ball Valves”. Isolation valves shall be provided at all equipment connections.

2.07 DUCTWORK

A. The odor control system manufacturer shall provide all necessary ductwork, expansion joints, dampers and supports from the fan inlet to the chemical scrubber vessel exhaust. Ductwork and ancillary components shall meet the requirements of Section 13252, FRP Ductwork.

2.08 WATER SOFTENER

A. Provide a pre-assembled, skid-mounted, combination water softener and reverse osmosis unit using ion exchange resin to pre-treat the scrubber’s make-up water hardness.

B. Model shall be Vantage PTC Series Twin Softener manufactured by Evoqua Water Technologies, LLC, or, Culligan, Soft-Minder Twin Plus, Model SMS-91, or approved equal, and shall be rated as required by the OC Supplier.

C. The water softener shall have a flow capacity at least equal to the maximum required make-up water rate and shall be capable of removing hardness to no more than 1 grain/gallon. The unit shall be 115-volt, single phase (10 watts). The complete water softener system shall consist of one control valve, two mineral tanks, one brine tank, one

electromechanical meter, one extra cam and switch, and connecting pipe between vessels and resin. Recommended inlet pressure of 30-100 psig.

D. Each mineral vessel shall be a corrosion resistant composite, constructed of a polyethylene shell wound with continuous fiberglass fibers. Each vessel shall be supplied with high-capacity cation exchange resin. Each vessel shall include an inlet diffuser to evenly distribute the influent water, to collect backwash water and to introduce the brine regeneration solution.

E. One of the two mineral vessels shall be fitted with a top-mounted, five-cycle multiport control valve to operate the backwash, brining, slow rinse, fast rinse and refill cycles. An additional piston assembly shall be included to control the duty/standby status of the two vessels. A brass control valve including fixed and self-adjusting flow regulators shall be provided. A hydraulically balanced Teflon coated piston shall be provided to perform the cycles of regeneration.

F. A single salt storage tank shall be provided as part of the softener system. The salt storage tank shall be constructed of corrosion resistant polyethylene. The brink tank shall be equipped with an automatic air eliminator safety valve which shall be attached to the brine line and housed within a chamber inside the brine tank. The brine valve shall automatically open to educt the brine into the softener tank, close to prevent eduction of air, and refill the brine tank with the proper amount of water.

G. Water softener system shall be provided with NEMA 4, UL-rated controls and a fused power distribution panel with disconnect switch and a single electrical connection.

H. System shall be controlled with an SXT programmable controller. This controller shall include a power backup system that continues to keep time for a minimum of 48 hours in the event of a power failure. The system configuration shall be stored in a non-volatile memory, maintained with or without power, indefinitely. Regeneration shall be set initiated by three methods: totalized volume (immediate or delayed)., programming (time clock or day of week), or via the operator manually initiating the regeneration.

2.09 POLYETHYLENE STORAGE TANKS

A. Provide cross-linked high-density polyethylene storage tanks for 50% sodium hydroxide and 12.5% sodium hypochlorite.

B. Conditions of Service/Storage Tank Schedule:

	Sodium Hypochlorite Bulk Tank	**Sodium Hydroxide Bulk Tank**
Number of Tanks	One (1)	One (1)
Material	Polyethylene	Polyethylene
Max Solution Concentration	12.5%	50%

	Sodium Hypochlorite Bulk Tank	Sodium Hydroxide Bulk Tank
Specific Gravity	1.2	1.15
Freezing Point	-17°F @ 12.5%,	54°F @ 50%
Design Temperature	35-120 degrees F	35-120 degrees F
pH	13	14
Type	Vertical, Cylindrical	Vertical, Cylindrical
Bottom Configuration	Flat Bottom	Flat Bottom
Top Configuration	Dome Top	Dome Top
Useable Capacity (to invert of overflow, minimum)	3,000 gallons	850 gallons
Maximum Diameter	7'-6"	4'-0"
Maximum Straight Shell Height	8'-11"	9'-1"
Maximum Overall Height	10'-2"	10'-0"
Connection Openings*:		
1) Fill Line	2"	2"
2) Metering Pump Suction	1"	1"
3) Drain Line	2"	2"
4) Overflow Line	3"	3"
5) Vent	4"	4"
6) Manway Diameter (Top)	1'-4"	1'-4"
7) Radar Level Instrument**	Yes	Yes
8) Sight Gauge**	¾"	¾"
Heating Panels and Insulation Design Temperature / Minimum Ambient Temperature	No	Yes
Materials of Construction for Metal Components in Containment Area	Hastelloy-C/Titanium	Hastelloy-C/Titanium
Materials of Construction for Metal Components above Containment Area	316 Stainless Steel	316 Stainless Steel
Materials of Construction for Elastomers	Viton	EPDM
Containment Wall Height	Refer to Drawings	Refer to Drawings
Exposure	Outdoors	Outdoors

** Refer to Drawings for Location, Orientation, and Elevation of Connections*

	Sodium Hypochlorite Bulk Tank	Sodium Hydroxide Bulk Tank

** *Coordinate with Instrument Supplier*

C. Tanks are to conform to applicable sections of the following standards except where otherwise specified herein.

1. The work of this section shall comply with the most current edition of the Florida Building Code.

2. American National Standards Institute (ANSI)

   a. ANSI B16.5 – Pipe Flanges and Flanged Fittings.

3. American Society of Testing Materials (ASTM)

   a. ASTM D638 – Standard Test Methods for Tensile Properties of Plastics.

   b. ASTM D746 – Brittleness Temperature of Plastics and Elastomers by Impact.

   c. ASTM D790 – Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.

   d. ASTM D883 – Standard Definitions of Terms Relating to Plastics.

   e. ASTM D1505 – Density of Plastics by the Density-Gradient Technique.

   f. ASTM D1525 – Vicat Softening Temperature of Plastics.

   g. ASTM D1693 – ESCR Spec. Thickness .125” F50-10% Igepal.

   h. ASTM D1998 – Standard Specification for Polyethylene Upright Storage Tanks.

D. Acceptable Manufacturers: The polyethylene storage tank(s) shall be as manufactured by Assmann Inc., Snyder Industries, Poly Processing Company, or approved equal.

E. Materials and Construction:

1. Each tank shall be one-piece construction, rotationally molded, high-density cross-linked polyethylene. Tank shall have a specific gravity rating of 1.5 and shall be completely resistant to corrosion by the specified chemicals. The Contractor and tank manufacturer shall be fully responsible for the structural design and integrity and watertightness of the tank, including all anchorages and connections. Each

tank shall be capable of storing the specified chemical at temperatures up to 130°F.

2. The plastic shall not contain any fillers. All plastic shall contain a long-term UV stabilizer.

3. The nominal properties of the material are as follows based on molded parts:

Property	ASTM Specification	Value
Density	D1505	0.943 to 0.946 g/cc
ESCR Condition A, F50 100% Igepal 10% Igepal	D1693	 F_0 > 1,000 hours F_0 > 1,000 hours
Tensile Strength at Yield 2 in/min	D638	2,700 – 2,900 psi
Elongation at Break 2 in/min.	D638	640 percent
Flexural Modulus	D790	110,000 psi
Impact Strength, -40 °C	ARM	450 ft-lbs
Deflection Temperature @ 66 psi	D648	157 °F

4. Design Requirements

   a. The minimum required wall thickness of the cylindrical shell at any fluid level shall be determined by the following equation but shall not be less than 0.187 in thick.

T	=	P x O.D./2 SD = 0.433 x S.G. x H x O.D./2 SD
T	=	wall thickness
SD	=	Hydrostatic design stress, PSI
P	=	pressure (.433 x S.G. x H), PSI
H	=	fluid head, ft.
S.G.	=	specific gravity, g/cm∧3
O.D.	=	outside diameter, in.

   b. The hydrostatic design stress shall be determined by multiplying the hydrostatic design basis, determined by ASTM D2837 using rotationally molded samples, with a service factor selected for the application. The hydrostatic design stress is 600 PSI at 73 degrees Fahrenheit.

c. The hydrostatic design stress shall be derated for service above 100 degrees Fahrenheit and for mechanical loading of the tank.

d. The standard design specific gravity shall be 1.5.

e. The minimum required wall thickness for the cylinder shell must be sufficient to support its own weight in an upright position without any external support.

f. For dome top tanks, the top head must be integrally molded with the cylinder shell. The minimum thickness of the top head shall be equal to the top of the straight wall. For open top tanks, the open top shall include a reinforcing flange provided for attaching a flat, hinged top. The minimum thickness of the flat top shall be equal to the top of the straight wall.

5. All tank capacities (volumes) specified shall include only that volume in the straight shell below the maximum tank fill level (below the overflow pipe invert elevation) and above the top of the outlet pipe. At least four inches of freeboard shall be provided between the top of the overflow pipe and the top of the straight shell.

6. Tanks shall be anchored to the concrete base by the Contractor in accordance with the Drawings. Tanks shall be designed to withstand flotation, assuming that the containment area is in a flooded condition and the tank is empty.

7. The tanks shall be cylindrical and vertical in orientation with tank penetrations as indicated on the Contract Drawings.

F. Connections and Accessories:

1. All connections/openings shall be flanged in accordance with ANSI B 16.5 150 pounds. Flanged connections, nozzles and openings shall be perpendicular to the straight shell of the tank. All required pipe supports, hardware, accessories, etc., shall be provided. All piping connected to the tanks shall be perpendicular or parallel to the straight shell of the tanks. All piping into the tanks shall be supported such that no weight is placed on the tank and its connections.

2. Each tank connection located on the lower third of the tank shall be provided with a flexible connector resistant to the specified chemical to allow for lateral and vertical expansion and contraction of the tank and to isolate the tank from pump and piping vibration. Flexible connectors shall be provided by the tank manufacturer.

3. Integrally Molded Flange Outlet: The tank discharge connection for below liquid installation shall be an integrally molded flange outlet. The flange outlet shall be of the same material as the tank. The flange outlet shall allow for full drainage of the tank. The external flange shall be ANSI Class 150 with a socket end. Hardware shall be Hastelloy C-276.

4. Sidewall fittings above the chemical fill level shall be Schedule 80 PVC or CPVC bulkhead fittings. Sidewall fittings below chemical fill level shall be as follows:

   a. Sodium Hydroxide: Bolted flange PVC or CPVC with either polyethylene- or EPDM-encapsulated bolts, or bolted one-piece polyethylene with backing ring designed to reduce stress on the fitting.

   b. Sodium Hypochlorite: Hastelloy C-276.

5. Threaded Bulkhead Fittings: Provide threaded bulkhead fittings for above liquid installation for fittings up to two inches in diameter. Tank wall thickness shall be considered for bulkhead fitting placement and the maximum wall thickness for each fitting size is shown below:

Fitting Size	Maximum Wall Thickness (inches)
1/2 inch	0.750
3/4 inches	0.875
1 inch	0.875
1 1/4 inches	0.875
1 1/2 inches	0.875
2 inches	1.0

6. Opening for pump suction line and drain line outlet shall be integrally molded full drain outlet. Bolts and gaskets shall be constructed of materials as specified.

7. Connections at the top of the tank shall be self-aligning flanges or bulkheads fitting when required for plumbing or instrument installation. Fittings shall be constructed of CPVC with Viton gaskets. Hardware shall be Hastelloy C-276.

8. Vent lines shall be top-mounted. Each vent shall be extended to the atmosphere and shall have a PVC vent insect screen. Vent lines shall be supplied and installed by the Contractor as shown on the Drawings or as directed by the Engineer.

9. Tank fill lines shall be as shown on the Drawings. All pipe supports, hardware, accessories, etc., shall be provided. Vertical piping into the tanks shall be supported every five feet and shall be parallel to the tank wall and not less than 6 inches from the tank wall.

10. Fill Station: Each storage tank fill line shall be provided with a cam lock type quick connect coupling with downstream ball valve as shown on the Drawings for connection to the delivery vehicle. The dry quick connections shall be resistant to corrosion by the specified chemicals and shall be provided with fittings, quick lock

coupling and dust cap and chain. Quick connect couplings shall be provided by the Contractor as specified in Section 15000 – Basic Mechanical Requirements. The Contractor shall furnish and install a sign at each chemical fill station to identify the chemical filled. The signage shall be as specified in Section 10400 – Identifying Devices.

11. Each tank shall be provided with an overflow pipe as specified and indicated on the Drawings. The Contractor shall provide a Flange Insert Check Valve (FIV) for each overflow pipe. The FIVs shall be complete with unions, liquid traps, and flanges. The valves shall be flanged check valve type inserted between two mating flanges. The valves shall be the same size as the tank overflow line. Each valve shall have a cracking pressure of 1/2 psig. The valve bodies shall be constructed of PVC, and valve seats and metal springs shall be as specified. The flange insert valves shall be as manufactured by Check-All Valves Manufacturing Company, or equal.

12. Level Sensor Mounting Provisions: Each tank shall be provided with a minimum 4 inch diameter flanged nozzle with a blind flange for mounting a radar level transducer in accordance with Division 17. The radar transducer shall be mounted with a bracket attached to the blind flange, as shown on the Instrumentation Detail Drawings. The mounting and connecting requirements, required clearance between mounting flange and tank wall, and height above liquid level, shall be coordinated with the Division 17 Instrument Supplier.

13. Manway: Each tank shall be provided with a top-mounted chemically resistant manway with gasket and bolt-on type cover. Materials of construction shall be as specified for the chemical to be stored.

14. Sight Level Gauge Provisions: Each tank shall be equipped to allow for installation of a visual liquid level gauge furnished by the Division 17 Instrumentation Supplier under Section 17690 “Sight Level Indicators”. The mounting and connecting requirements shall be coordinated with the Division 17 Instrumentation Supplier.

15. Access Ladder: Each storage tank shall be equipped with an exterior access ladder for access to the manway(s) at the top of the tank. Ladder shall be constructed of FRP. Ladder shall meet OSHA requirements. Ladders shall be furnished with all required mounting hardware, accessories, anchor bolts, bands, base brackets, etc. for a complete installation. Mounting hardware shall be Hastelloy C. Angle clips shall be furnished for mounting the bottom of the ladder to the concrete pad. Ladders shall be furnished with gooseneck handrails at the top. The tank top shall be equipped with ladder clips to bolt ladder handrails thereto.

16. Lifting Lugs: The tank shall be provided with a minimum of three lifting lugs. Lifting lugs shall be capable of withstanding weight of an empty tank with a safety factor of 3 to 1.

17. Tie Down Lugs, Tie Down Cables and Anchor Bolts: Each tank shall be provided with a restraint system with necessary cable assemblies, anchor clips and anchor bolts. Anchor clips shall be 316 stainless steel, and cables shall be stainless steel. Anchor bolts shall be completely resistant to corrosion by the specified chemicals. Restraint system shall withstand wind load calculated in accordance with current Florida Building code, and buoyancy of empty tank in a containment area flooded to the top of the containment wall. Refer to Drawings for containment wall height. Anchor clips requiring holes through the side wall of the tanks shall not be allowed.

    a. The anchor clips and cables shall be designed and supplied by the tank manufacturer.

    b. The anchor bolts, nuts, washers, shims and related hardware shall be sized and provided by the Contractor. The Contractor shall size the anchor bolt anchoring depth and edge distance for the tank pad.

    c. Submit calculations, sealed by a Professional Engineer in the State of Florida, to verify that tie-down lugs and anchor bolts can withstand buoyancy and wind loads.

18. The tank shall be provided with a permanently attached label providing the following information:

    a. Name, concentration, and specific gravity of material stored

    b. Tank resin

    c. Tank dimensions and capacity

    d. Maximum temperature rating of tank

    e. Manufacturer

    f. Date of manufacture

19. All metallic parts, fasteners, brackets, mounting hardware, and accessories provided by the tank manufacturer shall be constructed of corrosion resistant metals as specified in the Tank Schedule.

G. Piping support:

1. All horizontal sections of piping inside the containment area and trench shall be supported by thermoplastic pads at maximum 5-foot intervals as shown in the Drawings to prevent the piping from resting directly on concrete.

2.10 ACCESSORIES

A. Make-up Water Control: The direct reading rotameter shall be a variable area type with a Teflon float, EPR “O” rings, and PVC fittings. The rotameter shall be of the same size as the pipe in which it is installed. The rotameter shall have a direct reading scale.

B. Scrubber Recirculation Sump Blowdown and Level Controls: The scrubber shall be operated with a manual blowdown. The rate of blowdown shall be proportional to the rate of make-up water.

C. Overflow Control: An overflow line equipped with an internal water seal shall maintain a minimum freeboard of four inches as measured from the maximum liquid level to the top of the scrubber sump deck.

2.11 PAINTING

A. All paint and coatings shall be shop applied in accordance with Section 09900 – Painting unless approved by the Engineer. Any painted surfaces that are damaged during handling, assembly, shipping, storage, and installation shall be cleaned, scraped back to soundly adhering paint, and repainted to equal the original painting received at the shop.

2.12 EQUIPMENT IDENTIFICATION

A. Each piece of equipment shall be provided with a substantial stainless-steel nameplate, securely fastened in a conspicuous place and clearly inscribed with the manufacturer’s name, year of manufacture, serial number and principal rating data.

2.13 ELECTRICAL, INSTRUMENTATION AND CONTROLS

A. General:

1. Furnish a complete operating control system for local and automatic control and remote monitoring of the System as specified in this Section. Panels shall be mounted as shown on the Drawings. Provide control panel and field instruments as described below.

2. A complete Odor Control System PLC panel, LCP-33, shall be furnished by the Section 13253 Odor Control Scrubber System supplier and integrated into the existing WWTP SCADA HMI and Historian by the Division 17 instrumentation and controls subcontractor. In addition to the LCP-33 panel and internal hardware, the local OIU-33 HMI graphic screens and PLC-33 logic shall be furnished by the Odor Control System Supplier. The Odor Control Scrubber System supplier’s scope of supply shall include the equipment and strategies shown on the Instrumentation Drawings. The Odor Control Scrubber System supplier shall be fully responsible for all PLC-33 logic programming, OIU-33 graphics programming and LCP-33 managed Ethernet switched configuration both prior to shipment of the panel and once the panel has been installed in the field and energized. Odor Control Scrubber System supplier shall coordinate with the CITY’s ICE department to

obtain the CITY's preferred IP addresses for PLC-33, OIU-33 and the LCP-33 managed Ethernet switch.

3. The CITY's preferred systems integrator/panel builders are as follows:

    a. C.C. Controls – Location: West Palm Beach, Florida Phone: (561) 293-3975

    b. Revere Control Systems – Location: Lakeland, Florida Phone: (863) 646-5781

4. Provide terminal junction wiring boxes on each modular odor control unit.

5. Junction boxes shall be made of materials rated for the area classification and for material compatibility with the chemicals contained within the scrubber module.

    a. All Modular Odor Control mounted instruments shall be installed in and wired to the junction box for connection to the remotely mounted LCP. Junction Box shall be sized so that all Modular Odor Control mounted equipment can be installed in and wired to the junction box.

    b. Provide a minimum of 15% spare terminals.

    c. Separate 460 volt wiring from 120volt wiring.

    d. Separate intrinsically safe wiring from all other wiring.

    e. Provide a separate terminal box for analog and low voltage signal wiring.

B. Odor Control System Local Control Panel (LCP):

1. In addition to the requirements described herein below, the LCP (LCP-33) shall meet or exceed the requirements of the Instrumentation Detail Drawings and the following Division 17 Sections:

    a. 17120, 17180, 17190, 17500, 17550, 17560, 17900, 17910, 17920

    b. LCP-33 shop drawing submittals shall meet section 17030 requirements

    c. Provide operator training per Section 17040 requirements

2. System shall be provided with a local control panel (LCP) as described herein. LCP shall have a single point of connection to 480 VAC, 3-phase power and shall be furnished with a main circuit breaker. Provide a main power supply disconnect circuit breaker rated 480 VAC, 65 kAIC. Additional circuit breakers shall be provided in the circuits of the system major pieces of equipment. The panels shall include all necessary circuit breakers and protective devices including lightning surge suppressors. The panel main breaker shall be sized to feed all equipment

and devices associated with the odor control systems as specified here in and indicated on the drawings.

3. LCP shall house all electric and electronic components required to monitor and control the operation of the system. Panels shall contain all motor controls (circuit breakers, motor starters, etc.) and shall be provided by the OC Supplier. The control panel shall be UL Listed and bear the "UL Listed Enclosed Industrial Control Panel" Label. NEMA rated electrical components shall be provided, IEC rated components are not acceptable.

4. The panel shall be equipped with a Modicon M340 Programmable Logic Controller (PLC) with a 4 port Ethernet/IP communications module and all digital and analog input and output modules required to provide the PLC-33 inputs and outputs required by Section 17920 and as described herein. The PLC shall meets or exceeds Section 17120 requirements.

5. The panel shall be equipped with a touchscreen operator interface unit (OIU-33) that meets or exceeds Section 17125 requirements.

6. The panel shall be equipped with a redundant loop power supply that meets or exceeds Section 17120 requirements.

7. The panel shall be equipped with surge protection devices that meet or exceed Section 17560 requirements.

8. A 120Vac UPS shall be provided for LCP-33 and shall meet or exceed Section 17190 requirements.

9. LCP enclosure shall be a double door, Type 316 stainless steel NEMA 4X panel powder coated white with sunshields as shown on the Instrumentation Detail Drawings. The panel shall be free standing with 12” 316 stainless steel legs and covers, constructed in accordance with UL 508 and UL 698 requirements for enclosed industrial control panels and shall bear the serialized UL label. Hinges, pins, latches and fasteners shall be 316 SST. The enclosures shall have a hinged outer door with suitable 3-point latching mechanisms and continuous gaskets to keep ambient corrosive gases from entering the panel when closed. The panels shall have a hinged inner door fabricated from 5052-H32, 0.080-inch thick-brushed marine alloy aluminum. The inner door shall be completely removable for ease of service. The inner door shall be held closed by mechanical latches. The subpanel shall be degreased, cleaned, treated with a phosphatizing process, then primed and painted with white industrial grade baked enamel. The enclosures and mounting systems shall be designed to withstand wind loads as required by applicable building codes.

10. The panel shall provide power and control for the fan, recirculation pumps, metering pumps, and all components supplied herein.

11. Panels shall be tagged as indicated on the Instrumentation Drawings.

12. All starters for the System equipment, including SCR drives for the metering pumps, shall be located in the LCP.

13. Exhaust Fan motor starter shall be located in the LCP.

14. All non-460 Volt loads shall be powered off an internal power transformer.

15. Main power disconnect circuit breaker device, mechanically interlocked with door so that the main power must be “OFF” before door can be opened.

16. Stainless steel, copper-free aluminum or FRP back panel with provisions to mount control devices and terminal strip for field connections.

17. Provide separate circuit breakers on the 120 VAC power to the following devices external to the panel as necessary:

    a. Division 17 Instrumentation Supplier furnished Radar Level Indicating Transmitters LIT-60011 and LIT-60031

C. Control System Features:

1. Operator Controls and Indications: Provide the following operator controls and indications at each local control panel for each odor control system:

    a. Selector Switches:

        1) Control power ON/OFF (Mounted to LCP inner door)

        2) Odor Control System START-STOP selector switch

        3) SYSTEM RESET Pushbutton

        4) LOCAL/REMOTE

    b. HMI Selector Switches:

        1) Odor Control Exhaust Fan HAND-OFF-AUTO selector switch

        2) Recirculation Pump #1 H-O-A

        3) Recirculation Pump #2 H-O-A

        4) Metering Pump #1 H-O-A

        5) Metering Pump #2 H-O-A

6) Metering Pump #3 H-O-A

c. Local Status Light Indication (Mounted to LCP inner door)

1) Power On

2) Common Alarm

3) System Running

4) System Stopped

d. OIU-33 HMI Screen Status Indication :

1) Power ON

2) Odor Control Exhaust Fan Running

3) Recirculation Pump #1 Running

4) Recirculation Pump #2 Running

5) Metering Pump #1 Running

6) Metering Pump #2 Running

7) Metering Pump #3 Running

8) Sump 1 pH value display

9) Sump 2 pH value display

10) Sump 2 ORP value display

11) Recirculation Pump #1 Failure (amber)

12) Recirculation Pump #2 Failure (amber)

13) Stage 1 Sump Low Level (red)

14) Stage 2 Sump Low Level (red)

15) Stage 1 Sump pH Alarm (amber)

16) Stage 2 Sump pH Alarm (amber)

17) Stage 2 Sump ORP Alarm (amber)

18) Odor Control Exhaust Fan Failure

19) Odor Control Exhaust Fan High Motor Temperature

20) Scrubber Stage 1 to 2 Differential Pressure

21) Scrubber Stage 2 Differential Pressure

22)

e. HMI Indication:

1) Sump 1 pH value display

2) Sump 2 pH value display

3) Sump 2 ORP value display

f. Adjustable Setpoint:

1) Sump 1 pH setpoint

2) Sump 2 pH setpoint

3) Sump 2 ORP setpoint

2. Discrete Inputs to PLC-33 shall be 24Vdc. Provide intrinsic safety barriers as required to meet code requirements.

3. HMI Elapsed Time Meter Display: Include six-digit non-resettable counter values with units in hours for each pump and fan HMI faceplate.

Control System Operation:

4. When the Odor Control Scrubber System Local/Remote selector switch on the LCP-33 inner door is set to Local mode Auto/Manual mode selection and local manual operation of the Odor Control Fan (OCF-60005), Stage 1 Recirculation Pump (RP-60001), Stage 2 Recirculation Pump (RP-60002), Sodium Hydroxide Metering pumps (MP-60011 and MP-60021) and Sodium Hypochlorite Metering pump MP-60031 shall be from OIU-33, remote control from the SCADA HMI shall be disabled. When Odor Control Scrubber System Local/Remote selector switch is set to Remote, control shall be from the SCADA HMI screen and local control from OIU-33 shall be disabled. Remote Auto and Local Auto modes shall utilize the same automatic strategy, described herein below. A faceplate graphic on the SCADA HMI Screen for each metering pump, recirculation pump and the exhaust fan shall allow for Remote Auto and Remote Manual mode selection and remote operation of each device.

5. When the Odor Control Scrubber System START-STOP selector is in STOP position, the System shall not run regardless of other run commands.

6. When the local switch is the START position, the System pumps and fan shall run.

7. Odor Control Exhaust Fan H-O-A selector (HMI Screen)

    a. When the selector is in AUTO, the fan shall run when the modular odor control scrubber is running.

    b. When the selector is in OFF, the fan shall not run.

    c. When the selector is in HAND, the fan shall run.

    In either AUTO or HAND modes, the Odor Control Exhaust Fan shall be shut down when any of the associated alarm conditions occurs (overload, high motor temperature).

8. Recirculation and Chemical Pump H-O-A selectors (HMI Screen)

    a. When the selector is in AUTO, the pumps shall run when the modular odor control scrubber is running.

    b. When the selector is in OFF, the fan shall not run.

    c. When the selector is in HAND, the fan shall run.

    d. In either AUTO or HAND modes, the Odor Control Exhaust Fan shall be shut down when any of the associated alarm conditions occurs (overload, high motor temperature).

9. Sodium Hydroxide Metering pumps, MP-60011 and MP-60021, shall both be duty pumps, with MP-60011 feeding sodium hydroxide to the Odor Control Scrubber Stage 1 Sump and MP-60021 feeding sodium hydroxide to the Stage 2 sump. When the metering pump keypad is set to local mode, the operator shall control metering pump speed from the built-in keypad on the pump. When the metering pump keypad is set to remote mode, the metering pump shall be controlled from PLC-33. An enable and speed reference signal shall be required to operate the pump from PLC-33.

    a. When the Odor Control Scrubber System Local/Remote selector switch on the LCP-33 inner door is set to Local mode Sodium Hydroxide Metering pump, MP-60011 and MP-60021, metering pump Auto/Manual mode selection and local manual operation shall be from OIU-33, remote control from the SCADA HMI shall be disabled. When Odor Control Scrubber System Local/Remote selector switch is set to Remote, control shall be from the SCADA HMI screen and local control from OIU-33 shall be disabled. Remote Auto and Local Auto modes shall utilize the same automatic strategy, described herein below. A faceplate graphic on the SCADA HMI

Screen for each metering pump shall allow for Remote Auto and Remote Manual mode selection for each pump.

b. Remote Auto –When the Odor Control Scrubber System Local/Remote selector switch (on the LCP-33 inner door) is set to Remote and Remote Auto is selected from the SCADA HMI screen for a Sodium Hydroxide pump, the system shall modulate the metering pump speed based on the automatic feed strategy described below.

c. Remote Manual –When the Odor Control Scrubber System Local/Remote selector switch (on the LCP-33 inner door) is set to Remote and Remote Manual is selected from the SCADA HMI screen for a Sodium Hydroxide pump, the system will modulate the metering pump speed based on a SCADA HMI adjustable speed set-point (0-100%).

d. Local Auto –When the Odor Control Scrubber System Local/Auto selector switch (on the LCP-33 inner door) is set to Local and Auto is selected from OIU-33 for a Sodium Hydroxide pump, the system will modulate the metering pump speed based on the automatic feed strategy described below.

e. Local Manual –When the Odor Control Scrubber System Local/Remote selector switch (on the LCP-33 inner door) is set to Local and Manual is selected from OIU-33 for a Sodium Hydroxide pump, the system will modulate the metering pump speed based on an OIU-33 adjustable speed set-point (0-100%). The adjustable speed set-point shall be the same tag in PLC-33 for both OIU-33 and the SCADA HMI.

f. Sodium Hydroxide Automatic Feed Strategy - sodium hydroxide metering pump SCRs shall be modulated to maintain the corresponding sump pH setpoint based on pH indicating transmitter feedback.

10. Sodium Hypochlorite Metering pump MP-60031 shall feed sodium hypochlorite to the Stage 2 sump. When the metering pump keypad is set to local mode, the operator shall control metering pump speed from the built-in keypad on the pump. When the metering pump keypad is set to remote mode, the metering pump shall be controlled from PLC-33. An enable and speed reference signal shall be required to operate the pump from PLC-33.

    a. When the Odor Control Scrubber System Local/Remote selector switch (on the LCP-33 inner door) is set to Local mode Sodium Hypochlorite Metering pump, MP-60031 Auto/Manual mode selection and local manual operation shall be from OIU-33, remote control from the SCADA HMI shall be disabled. When Odor Control Scrubber System Local/Remote selector switch is set to Remote, control shall be from the SCADA HMI screen and local control from OIU-33 shall be disabled. Remote Auto and Local Auto modes shall utilize the same automatic strategy, described herein below. A faceplate graphic on

the SCADA HMI Screen for each metering pump shall allow for Remote Auto and Remote Manual mode selection for each pump.

b. Remote Auto –When the Odor Control Scrubber System Local/Remote selector switch (on the LCP-33 inner door) is set to Remote and Remote Auto is selected from the SCADA HMI screen for a Sodium Hypochlorite pump, the system shall modulate the metering pump speed based on the Odor Control Scrubber System Suppliers' automatic feed strategy.

c. Remote Manual –When the Odor Control Scrubber System Local/Remote selector switch (on the LCP-33 inner door) is set to Remote and Remote Manual is selected from the SCADA HMI screen for a Sodium Hypochlorite pump, the system will modulate the metering pump speed based on a SCADA HMI adjustable speed set-point (0-100%).

d. Local Auto –When the Odor Control Scrubber System Local/Remote selector switch (on the LCP-33 inner door) is set to Local and Auto is selected from OIU-33 for a Sodium Hypochlorite pump, the system will modulate the metering pump speed based on the Odor Control Scrubber System Suppliers' automatic feed strategy.

e. Local Manual –When the Odor Control Scrubber System Local/Remote selector switch (on the LCP-33 inner door) is set to Local and Manual is selected from OIU-33 for a Sodium Hypochlorite pump, the system will modulate the metering pump speed based on an OIU-33 adjustable speed set-point (0-100%). The adjustable speed set-point shall be the same tag in PLC-33 for both OIU-33 and the SCADA HMI.

f. Sodium Hypochlorite Automatic Feed Strategy - sodium hypochlorite metering pump SCRs shall be modulated to maintain the corresponding sump pH setpoint based on ORP indicating transmitter feedback.

11. Bumpless Mode Transition - The transition between Automatic and Manual modes shall be bumpless.

12. System Interlocks - When the local switch is in the START position, the Local Control Panel controls the System based on the inputs from field devices or discrete inputs:

    a. Each low level sump switch shall shut off the recirculation pump and chemical metering pump associated with the sump and provide an alarm.

    b. Upon receiving a low chemical storage tank level, the control system is to stop the associated metering pump(s) from operating and provide an alarm.

13. All alarm conditions are to latch and require that the RESET button on the LCP be pressed to reset the system. The LCP strobe shall activate when an alarm condition is present.

14. Upon loss of power, system control is to reset and restart the system based on control inputs.

D. Electrical Components and Accessories:

1. General: Furnish and install all necessary electrical components, including all conduit, wiring, and terminations for a complete, functional system.

2. Unless otherwise indicated, the control panels shall be dead fronts and the pilot devices shall be mounted internally of the respective enclosures. Pushbuttons, selector switches, and pilot lights shall be 30.5 mm, heavy-duty, oil tight type with provisions to maintain the NEMA ratings of starter enclosures. Legend plates indicating switch positions shall be provided for each pilot device. Pilot lights shall be LED type, push-to-test.

3. Motor Starters: Full voltage, combination type, non-reversing starter with overload relays, control power transformers, reset push-buttons, circuit breaker through-the-panel operators for each motor. Motor starters to be NEMA sized with a minimum size of NEMA 1. The magnetic starter to be of the heaterless design and provide phase loss protection, short circuit self-protection and provide thermal memory. The solid-state overload shall be self-powered. The contactor shall feature double-break silver cadmium oxide contacts, pressure type terminals, arc barriers, free floating armature magnet frame, molded continuous duty coil and stainless steel springs. Starter overload heater coils shall be sized to protect installed motor at full load AMP rating. The motor starters shall be Square D or approved equal.

4. Motor Power and Control Circuit Breakers: Provide breakers for each motor power circuit and a breaker for the 120V power and control circuits. Provide branch circuit breakers for the panel receptacle and light, panel A/C light and 120V control panel as required.

5. Control power transformer to be sized for anticipated loads from devices/controls.

6. Power/Phase Monitor: A power monitor relay shall be installed and connected to the control logic. When the relay is deactivated, it shall disconnect control power to the motor starter. The relay shall be deactivated in the event of phase loss, phase reversal, or low voltage. The phase monitor relay shall be a Diversified Model SLA-440-ASA or equal.

7. Selector switches shall be SPDT, two or three position selector switches. Reset pushbuttons for all motors shall be momentary contact type with black operator. The selector switches and pushbuttons shall be Square D Type SK, A/B type 800H or equal.

8. Lightning/Surge Arrestor: A secondary arrestor, complying with ANSI 62.41 – latest revision, shall be installed on the line side of the main breaker in accordance with manufacturer's instructions. Arrestor shall be intermatic model AG6503C or equal.

9. 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.

10. Pilot devices shall be 30.5 mm heavy-duty nonmetallic NEMA 4X, Square D, Class 9001, Type SK or equal.

    a. Pushbuttons shall be extended guard type. Pushbuttons and selector switches shall be non-illuminated.

    b. Pilot lights shall be LED, push-to-test type. Pilot light lens colors shall be as follows:

        1) Red – "Run", "On", "Open"

        2) Green – "Off", "Closed"

        3) Amber – "Alarm", "Fail"

        4) White – "Control Power On"

11. Electronic Indicators (if used): Electronic indicators shall be 3.5 or 6 digit, as appropriate, with 0.56" high red LED display. Indicators shall be provided with nameplate and scale calibrated to match the calibration of the primary element. The unit shall be designed primarily for use with 4-20 mA current loop signal circuits. Indicator operating voltage shall be 115 VAC 10%, 60 Hz. Indicator controls shall include three (3) front-panel pushbuttons for modifying alarm values and other indicator setup. Two (2) form-C relays shall be provided for each indicator. Relay contact outputs shall be rated 5A, 120/240 VAC, resistive load. Indicators shall be Red Lion Model IMP or APLCL, or equal.

12. Conduits:

    a. Liquid-tight, PVC-coated, non-metallic, flex between fixed conduit and metering pumps and field devices or as otherwise required for Class I, Division 1, Group D hazardous areas. Panel seal-offs to provide terminations on either side of the epoxy-based seal-off material to allow for replacement of cable without breaking the seal.

13. Wiring (Inside Panels):

    a. Control wiring stranded copper, minimum #14 AWG.

    b. Power wiring stranded copper, minimum #12 AWG.

    c. Insulation dual-rated for type THHN and THWN applications.

    d. Power terminals lug-type, 600 V minimum rated, with separate bare copper ground lugs for incoming and pump ground wires.

    e. Control terminals screw type, 300 V minimum rated, with minimum 10% or 6 spare terminals (whichever is greater).

    f. External control wiring terminations to be vinyl-insulated crimp connectors with spade lugs.

    g. Separate analog wiring by at least 6 inches from any AC power and control wiring.

    h. Enclose wiring in sheet metal raceways or plastic wiring ducts.

14. Identification:

    a. Provide legend plates as follows:

        1) Pilot Devices - Aluminum with black background and white letters, mechanically attached with pilot device.

        2) Controlled Device – 1” wide black plastic with 3/8” white engraved lettering, attached with stainless steel screws or epoxy.

        3) Control Panel – 1” wide black plastic with 3/8” engraved white lettering, attached to exterior door with stainless steel screws or epoxy.

        4) Tag all instruments mounted behind panel with embossed plastic tape labels.

    b. Wire Identification:

        1) Wire Tags: Snap-on or slip-on PVC wire markers with legible machine printed markings and numbers. Do not use adhesive or taped-on tags.

        2) Numbered and tagged at each termination.

    c. Color coding shall be as follows:

        1) Power – black

2) Switched hot – red

3) Neutral – white

4) Switched neutral – yellow

5) Ground - green

15. Laminated or etched aluminum “As Built” copy of the panel wiring diagram shall be provided and applied to the inner side of the enclosure door.

16. Terminals: A minimum of one, 10-pole terminal block mounted on a 30-degree angle shall be provided as a minimum for interface with field installed equipment for the ease of field connection. Additional terminal blocks shall be added as needed in 10-pole increments. Terminal blocks shall be mounted with a minimum of 2” from both enclosure sides and a minimum of 1” from the bottom of the enclosure for easy access to the terminal screws.

17. Mounting Hardware: All mounting hardware such as screws or bolts used in the manufacturing of the control panel shall be stainless steel. All holes in the back plate and dead front shall be drilled and tapped. No self-tapping screws, adhesive tapes, or Velcro will be accepted for mounting any hardware.

18. Corrosion protection: Panel interior components shall be treated with a corrosion inhibiting spray on all exposed metallic surfaces, particularly terminations, contacts and wire ends. After installation, furnish corrosion inhibiting capsules that emit molecular level coating on metallic surfaces throughout the panel that provide specific corrosion barrier toward hydrogen sulfide and/or subsequent formation of sulfuric acid when combined with ambient moisture.

E. Field Control Equipment:

1. Devices within the scrubber enclosure shall be rated for Class I, Division 1, Group D hazardous areas.

2. Devices located within a 3 foot envelope of the scrubber, associated ducting, and fans shall be rated for Class I, Division 2, Group D hazardous atmospheres.

3. pH Element/Transmitters shall be provided under this Section and shall be by Hach, YSI or Engineer Approved Equal. Sensors and transmitters shall be rated for sensor operation in Class I, Division 1, Group D hazardous areas.

4. ORP Element/Transmitters shall be provided under this Section and shall be by Hach, YSI or Engineer Approved Equal. Sensors and transmitters shall be rated for sensor operation in Class I, Division 1, Group D hazardous areas.

5. Differential Pressure Indicating Transmitters: Provide a Stage 1 to 2 differential pressure and Stage 2 to Mist differential pressure transmitter per Section 17760 requirements.

6. Level Switches: OC Supplier's standard switch designed for the intended service and corrosion-resistant construction. Provide intrinsically-safe circuits for the level switches.

7. Pressure Gauges shall be liquid-filled, including all-plastic isolators and isolation valves, shall be provided under this Specification Section for installation in the pump discharge piping. The gauges shall have a minimum dial size of 3½ inches. The gauge faces shall indicate units of measurement and the normal operating reading shall be near the midpoint of the range. Each gauge shall be provided with a diaphragm seal constructed of materials which are completely resistant to corrosion by the chemicals referred to in this Section. Each pressure gauge shall also be provided with an isolation valve. Isolation valves shall be PVC with seals that are resistant to the chemical applications.

2.14 TOOLS, SUPPLIES, AND SPARE PARTS

A. Furnish all special tools (one set per like piece of equipment) necessary to disassemble, service, repair, and adjust the equipment.

B. All spare parts furnished with the equipment are to be painted or coated as required in Section 09900 – Painting. Where no painting or protective coatings are specified, suitable provisions are to be made to protect against corrosion.

C. All spare parts are to be identical and interchangeable with the original parts and are to be furnished in clearly identifiable and labeled containers.

D. Provide all spare parts as recommended by the various equipment manufacturers. Include the following at a minimum:

1. One (1) set of gaskets for all gasketed covers and connections.

2. One (1) set of spray nozzles.

3. One (1) spare pH probe.

4. One (1) spare ORP probe.

5. One (1) impeller tool for the recirculation pumps (if applicable).

6. Two (2) spare pressure gauges with diaphragm protectors (for each service)

7. One (1) spare pressure relief valve (for each service)

8. One (1) spare back pressure valve (for each service)

9. One (1) spare pulsation dampener (for each service)

10. One (1) spare parts (i.e., preventive maintenance) kit including all components required to rebuild pump head (one for each pump)

E. All of these materials are to be properly packed, labeled and stored where directed by the CITY.

2.15 EQUIPMENT IDENTIFICATION

A. Each piece of equipment shall be provided with a 16-gauge stainless steel equipment identification plate or label laminated into the final fiberglass coat, in accordance with Section 11000 – Equipment General Provisions, which shall be securely fastened in a conspicuous place and clearly inscribed with the manufacturer's name, date of manufacture, serial number, capacity in cfm, design pressure, resin, minimum thickness, vessel name, etc. as applicable.

PART 3 – INSTALLATION

3.01 QUALITY ASSURANCE

A. Inspection and Testing Requirements: The Engineer reserves the right to reject delivery of any or all pieces of equipment found, upon inspection, to have any or all of the following: blisters, chips, crazing, exposed glass, cracks burned areas, dry spots, foreign matter, surface porosity, sharp discontinuity or entrapped air at the surface of the laminate.

B. Provide the services of an independent FRP Testing Inspector to be present at the point of manufacture, upon completion of fabrication and prior to shipment, to perform or witness the following:

1. Visual inspection to the requirements of ASTM D2563 Level II.

2. Barcol Hardness measurements per ASTM D2583-87.

3. Acetone sensitivity test for all internal secondary bonds.

4. Glass content by ignition loss on three cutouts per ASTM D2584.

5. Hydrostatic leak test: Fill to two (2) feet above vessel sump; allow to stand for 2 hours with no visible signs of leakage.

C. A one (1) inch diameter FRP sample shall be taken at a point on the vessel wall where a penetration or access manway will be located to prevent patching of sample locations. The analysis shall be performed by Ashland Chemical Co. Analytical Services & Technology Group, Dublin, OH, or equal. The analysis shall use FT-IR spectra and a

micro-ATR sampling accessory on a Varian UMA600 IR microscope. The cost of analysis and shipping shall be by the OC Supplier.

D. The Engineer reserves the right to be present at the fabricator's facility for visual inspection of equipment to be supplied. Visual inspection shall be performed prior to application of the exterior UV-resistant gel coat.

3.02 INSTALLATION

A. All equipment shall be assembled and shipped so that field assembly will be minimized and installation can be completed with little or no field fabrication.

B. All parts shall be properly protected so that no damage or deterioration will occur in transit or during prolonged storage at the site. All openings in equipment shall be protected against entry of foreign objects.

C. Each box, crate, and package shall be properly marked to show its contents and net weight.

D. Install the equipment in accordance with the OC Supplier's drawings and instructions. All FRP work shall be protected from atmospheric or otherwise induced conditions of adverse temperatures, moisture, wind, or blowing dust and sand and other contaminants that would adversely affect the laminate or joint construction. The protective means shall be provided during the construction and curing period.

E. Lubricate all equipment and make ready for operation.

F. Upon completion of the installation, each piece of equipment and each system is to be tested for satisfactory operation without excessive noise, vibration, overheating, etc. Compliance shall be based on the equipment manufacturer's specifications and all applicable costs to meet those standards shall be borne by the Contractor. All equipment must be adjusted and checked for misalignment, clearances, supports, and adherence to safety standards.

G. Deliver fans in manufacturer's original unopened packaging with brand name clearly marked and showing to jobsite with sufficient protection, bracing, etc. to ensure arrival in acceptable and undamaged condition.

H. Lift and support units with the manufacturer's designated lifting or supporting points.

I. Store in original containers on level supports and protect materials from damage and exposure to the elements until installed. Do not keep in storage for over 90 days.

J. All cut edges of fiberglass shall be coated with the specified resins prior to installation.

K. All metallic fasteners, brackets, mounting hardware, and accessories located in chemical storage and feed areas shall be constructed of corrosion-resistant metals as specified in the Tank Schedule.

L. All tanks shall be mounted on concrete pads only when demonstrated to be fully cured. The finished surface of each tank bottom shall be sufficiently flat, smooth, and free of irregularities, to prevent the possibility of tank failure from point loads or other sources.

M. The Contractor shall install 2 layers of EPDM between each concrete pad and storage tank, if recommended by the tank manufacturer. The tanks shall be installed on level pads.

3.03 SYSTEM START-UP

A. Start-up and testing of the System shall be performed in accordance with the requirements of Section 01650 – Equipment Testing and Plant Startup and Section 11000 – Equipment General Provisions, and the requirements herein.

B. Complete instrumentation and controls testing in accordance with Sections 17070 and 17072 in coordination with Division 17 instrumentation and controls subcontractor.

C. System start-up shall be performed by the OC Supplier and shall commence only after a visual inspection confirming proper installation by the OC Supplier's representative. OC Supplier shall provide any specialized equipment and materials required during start-up.

D. All testing shall be done in the presence of the Engineer and the OC Supplier or their approved representative.

E. The Odor Control System Supplier shall provide services as follows:

1. Field test and calibrate equipment and demonstrate to the Engineer that all equipment satisfactorily performs as specified.

2. Submit field testing reports and certification of proper installation to Engineer and City.

3. Submit start-up data report to Engineer and City.

4. OC Supplier or OC Supplier's representative shall perform the field tests required.

5. List and recommend corrective action for any deficiencies found.

6. Record inlet air temperature, inlet air relative humidity, inlet airflow rate, media differential pressure, inlet and outlet concentrations of hydrogen sulfide, and other data as may be appropriate.

7. All data shall be submitted to the Engineer and City in written report form. Field testing report shall include, at a minimum, description of testing procedure,

summary of all data collected in tabular form, operational comments, confirmation of compliance with performance requirements, and recommendations/corrective actions (if necessary).

3.04 FIELD ACCEPTANCE TESTS

A. Field acceptance tests are required for the System specified herein within 12 months of delivery of the equipment. All equipment shall be field tested in accordance with the applicable requirements of Section 01650 – Equipment Testing and Plant Startup and Section 11000 – Equipment General Provisions. No performance or field test shall begin until all air flow rates have been adjusted and balanced in accordance with Section 13252 – FRP Ductwork for Odor Control Service. Functional Testing is to include the mechanical tests and performance tests as specified below. Submit information which fully describes the OC Supplier's testing procedure. Provide at least ten days' notice of such tests. Engineer will witness the acceptance tests. In case of failure of any unit to meet the test requirements, make alterations as necessary, and repeat the tests at no additional cost to the City until the equipment is satisfactory. Submit certified report of successful field acceptance and mechanical tests.

B. Mechanical Test - The entire System with other associated equipment such as fans, recirculation pumps, and metering pumps, piping, and controls are to be mechanically tested for at least 4 hours after initial installation. Test is to be made with recirculation scrubber liquid and airflow being introduced at the design flow rates. All equipment is to be mechanically sound, show no evidence of liquid or gas leaks, have no undue vibrations and generally be structurally rigid when being tested.

C. Prior to conducting the Performance Tests, the Contractor shall re-examine the media level and add additional media as required to compensate for any settling of the bed.

D. Performance Test - Field test the System over a period of two (2) days to demonstrate compliance with the design conditions of service. Submit written documentation indicating the proper operation of all system components to the Engineer prior to performance testing. Each performance test shall be witnessed by the Engineer at the Engineer's discretion.

1. At a minimum, the OC Supplier shall furnish the following items:
    a. Portable manometer with a range of 0 to 10 inches W.C. for differential pressure loss across the scrubber media bed (as measured in inches W.C.).
    b. Air velocity meter for airflow measurement (cfm) into the odor control vessel.
    c. Portable H_2S analyzer and data logger (Odalog, AcruLog, or Interscan) for measurement of inlet H_2S gas concentrations. H_2S data logger range of measurement shall be compatible with the design concentrations specified in Part 1.02.
    d. Portable H_2S analyzer (Odalog, AcruLog, or Jerome 631-X) for measurement of exhaust H_2S gas concentrations. H_2S analyzer range of

measurement shall be compatible with the expected exhaust concentrations specified in Part 1.02.

e. Contractor to provide all water, power, labor, and equipment that the Odor Control System Supplier's field engineer requires for conducting the tests.

2. H_2S Test Procedures: Removal of H_2S from the inlet air stream must be greater than or equal to 99.5 percent of the inlet concentration. Each test is to be conducted with a fixed quantity of chemical or chemicals. H_2S inlet and exhaust concentrations shall be continuously measured (maximum 5-minute intervals) and the data logged by the instrument data loggers for a minimum of 24-hours. H_2S sampling methods shall conform to the following standards:

   a. Prior to commencing recording exhaust concentration, the system should be allowed to reach concentration equilibrium. Inlet and exhaust H_2S concentrations are to be continuously monitored and recorded using the analyzers as specified herein.

   b. Inlet concentration data shall be collected from the inlet ductwork to the System. Exhaust samples shall be taken from the System exhaust stack.

   c. In addition to monitoring and recording inlet and exhaust H_2S concentrations, the following data shall be recorded at 2-hour intervals over the two-day performance testing duration:

      1) Air flow rate.
      2) ORP and pH in each stage.
      3) Pressure drop across scrubber.
      4) Chlorine residual in each sump.

   d. Should the System performance not meet the requirements outlined in Part 1.02, the System shall have failed the performance test. The OC Supplier shall make any additions or modifications to the System as may be necessary, at no additional cost to the City, and the performance tests for that System shall be repeated in their entirety.

E. OC Supplier’s representative witnessing the field tests is to furnish the City, through the Engineer, a written report certifying that the System:

1. Has been properly installed and accurately aligned.

2. Is free from any undue stress imposed by connecting piping and/or anchor bolts.

3. Has been operating under a range of load conditions and that the System operates satisfactorily.

4. The Contractor has accurately recorded the data obtained during the field test.

F. Any failure or malfunction of equipment or controls shall cause the test to be invalidated, and the test shall be repeated.

- END OF SECTION -

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 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:

Pipe Size	Waterstop Flange Diameter	Waterstop Flange Thickness
4" - 12"	OD + 3.10"	0.50"
14" - 24"	OD + 4.15"	0.75"
30" - 36"	OD + 4.50"	1.00"
42" - 48"	OD + 5.00"	1.25"
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.

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 polyvinylidelene 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 15008 – SMALL PVC NON-PRESSURE PIPE

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. The CONTRACTOR shall furnish and install all 4 to 15-inch Underground PVC nonpressure pipe for gravity drain lines and all appurtenant work, complete in place, all in accordance with the requirements of the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Excavation and Backfill for Utilities

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Commercial Standards:

ASTM D 1784	Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
ASTM D 2241	Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR-Series).
ASTM D 2321	Recommend Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe.
ASTM D 3034	Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

1.04 CONTRACTOR SUBMITTALS

A. Samples: The CONTRACTOR shall submit to the ENGINEER for review, samples of all the materials proposed for use on the Work. The samples shall be clearly marked to show the manufacturer's name and product identification and shall be submitted along with the manufacturer's technical data and application instructions. All sample submittals shall conform to the requirements for Samples in Section entitled "Submittals."

B. Shop Drawings: The CONTRACTOR shall submit shop drawings and laying diagrams of all pipe, joints, bends, special fittings, and piping appurtenances in accordance with Section entitled "Submittals."

PART 2 – PRODUCTS

2.01 GENERAL

A. All PVC pipe shall be continuously and permanently marked with the manufacturer's name, pipe size, and pressure rating in psi.

B. The CONTRACTOR shall also require the manufacturer to mark the date of extrusion on the pipe. This dating shall be done in conjunction with records to be held by the manufacturer for 2 years, covering quality control tests, raw material batch number, and other information deemed necessary by the manufacturer.

2.02 PIPE

A. PVC pipe shall conform to ASTM D1785 and shall be made from a 12454B compound which is a Type 1, Grade 1 plastic as defined by ASTM D1784. Rerun or reclaimed materials will not be acceptable.

B. Wall Thickness shall be a minimum of Schedule 80, unless otherwise noted in the Section 15390 – Piping Schedule.

2.03 JOINTS

A. Pipe joints shall be provided as specified in the pipe schedule. Where required, socket type adapters and socket type flange adapters shall be provided.

B. All PVC pipe intended for buried service shall be socket weld joint.

C. Socket type joints shall be made up in accordance with ASTM D2855 with a PVC solvent cement complying with ASTM D2564. The cement shall have a minimum viscosity of 2000 cps.

D. Where flanges are to be used, flanges shall be van stone type with full faced vinyl gaskets.

2.04 FITTINGS

A. Socket type pipe fittings for schedule 80 pipe shall conform to ASTM D2467.

B. Fittings shall have the same schedule designation, joint type and be made of the same PVC compound as the connecting pipe.

PART 3 – EXECUTION

3.01 GENERAL

A. All material found during the progress to have defects will be rejected and the CONTRACTOR shall promptly remove such defective materials from the site of the Work.

B. Installation shall conform to the requirements of ASTM D 2321 and to the supplementary requirements or modifications specified herein. Wherever the provisions of this Section and the requirements of ASTM D 2321 are in conflict, the more stringent provision shall apply.

3.02 BEDDING MATERIAL

A. Unless otherwise specified or shown, all material used for pipe bedding shall conform to the requirements for "Embedment materials" as specified in ASTM D 2321.

3.03 TRENCHING AND BACKFILL

A. Trench excavation and backfill shall conform to the requirements of the Section entitled "Excavation and Backfill for Utilities," and as specified herein.

B. Unless Otherwise specified or shown, the maximum width of trenches shall be as specified in ASTM D 2321.

C. The minimum depth of cover over the top of the pipe shall be 36-inches unless otherwise shown on the Drawings.

3.03 LAYING PIPE

A. The pipe shall be installed in accordance with the requirements of ASTM D 2321 and as specified herein and shown and the sections shall be closely jointed to form a smooth flow line. Immediately before placing each section of pipe in final position for joining, the bedding for the pipe shall be checked for firmness and uniformity of surface.

B. Proper implements, tools, and facilities as recommended by the pipe manufacturer's standard printed installation instructions shall be provided and used by the CONTRACTOR for safe and efficient execution of the Work. All pipe, fittings, valves, and accessories shall be carefully lowered into the trench by means of backhoe, ropes, or other suitable equipment in such a manner as to prevent damage to pipe and fittings. Under no circumstances shall pipe or accessories be dropped or dumped into the trench.

C. Cutting and machining of the pipe shall be accomplished in accordance with the pipe manufacturer's standard procedures for this operation. Pipe shall not be cut with a cold chisel, standard iron pipe cutter, nor any other method that may fracture the pipe or produce ragged, uneven edges.

D. The pipe and accessories shall be inspected for defects prior to lowering into the trench. Any defective, damaged or unsound pipe shall be repaired or replaced. All foreign matter or dirt shall be removed from the interior of the pipe before lowering into position in the trench. Pipe shall be kept clean during and after laying. All openings in the pipe line shall be closed with water tight expandable type sewer plugs or PVC test plugs at the end of each day's operation or whenever the pipe openings are left unattended. The use of burlap, wood, or other similar temporary plugs will not be permitted.

E. Adequate protection and maintenance of all underground and surface utility structures, drains, sewers, and other obstructions encountered in the progress of the Work shall be furnished by the CONTRACTOR at its own expense under the direction of the ENGINEER.

3.04 HANDLING

A. Handling of the PVC pipe shall be done with care to insure that the pipe is not damaged in any manner during storage, transit, loading, unloading, and installation.

B. Pipe shall be inspected both prior to and after installation in the ditch and all defective lengths shall be rejected and immediately removed from the working area.

3.05 FIELD JOINTING

A. All pipe joints shall be made in accordance with the manufacturers written instructions.

B. The pipe shall not be deflected either vertically or horizontally in excess of the printed recommendations of the manufacturer of the coupling.

C. When pipe laying is not in progress, the open ends of the pipe shall be closed to prevent trench water from entering pipe. Adequate backfill shall be deposited on pipe to prevent floating of pipe. Any pipe which has floated shall be removed from the trench, cleaned, and relaid in an acceptable manner. No pipe shall be laid when, in the opinion of the ENGINEER, the trench conditions or weather are unsuitable for such Work.

3.06 PROTECTIVE COATINGS

A. Protective coating shall be as indicated in Section 15390 – Piping Schedule.

- 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 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 – Equipment and Materials

C. Section 15000 – Basic Mechanical Requirements

1.03 SUBMITTALS

A. Submit shop drawings in accordance with the Public Utilities 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

3 Union shall have socket-type ends, Viton o-rings, and shall be Schedule 80. Material shall be Type 1, Grade 1 PVC, per ASTM D 1784, Class 12454B.

3.02 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.

3.03 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.

A. Store fittings indoors in their original cartons.

B. 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.

C. 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:

Pipe Size (inches)	**Final Torque (foot-pounds)**
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 02222 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 15020 "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 09900 entitled, “Painting”.

3.10 HYDROSTATIC TESTING

A. Perform hydrostatic testing for leakage in accordance with requirements set forth in Section 15995 entitled “Pipeline Testing”.

- END OF SECTION -

SECTION 15013 – STAINLESS STEEL PIPE

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. The CONTRACTOR shall furnish and install stainless steel 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. Section 01300 – Submittals

B. Section 01600 – Materials and Equipment

C. Section 15000 – Basic Mechanical Requirements

D. Section 15390 – Schedules

E. Section 15995 – Pipeline Testing and Disinfection

1.03 SUBMITTALS

A. Submit shop drawings in accordance with the Section entitled “Submittals.”

B. Show material of construction, with ASTM reference and grade. Submit manufacturer's certificates of compliance with referenced pipe standards, e.g., ASTM A 312, A 403, A 778, A 774. Show wall thickness of steel cylinder.

PART 2 -- PRODUCTS

2.01 316 STAINLESS STEEL SCHEDULE 40S, 275 PSI CWP

A. Pipe, 1/4 inch through 12 inch, Schedule 40S, stainless steel, welded seam, annealed after welding, pickled and passivated.

B. Fittings, 2-1/2 inch through 12 inch, wrought stainless steel, butt-weld, annealed, pickled and passivated; 2000 lbs, socket-weld ends for 2 inch and smaller; alternatively, screwed ends for 2 inch and smaller where required to match valves or equipment.

C. Flanges, 1/4 inch through 12 inch, 150 lbs, forged stainless steel, weld-neck raised face or to match existing equipment.

D. Flange gaskets, 1/8 inch thick, full face EPDM or fluoroelastomer rated for 275 psig operating pressure, except for acid or caustic service. Full face Garlock style 3504 for acid service and full face Garlock style 3510 for caustic service.

E. Bolts and Nuts, stainless steel hex-head bolts and stainless steel heavy semi finished hex nuts.

F. Grooved-end couplings, 3/4 inch through 12 inch, galvanized ductile iron, EPDM gaskets, rolled or cut groove, Victaulic Style 77 flexible coupling and Style 89 rigid coupling, or equal.

G. Pipe components shall be manufactured in accordance with the following:

Material	ASTM	Dimensional ANSI
Pipe	A312, Gr TP 316L	B36.19
Fittings	A403, Gr CR 316L	B16.9
Flanges	A182, Gr F 316/316L	B16.5
Gaskets	-----	B16.21
Bolts	F593, Grp 2	B18.2.1
Nuts	F594, Grp 2	B18.2.2
Bolt Length	-----	B16.5
Bolt and Nut Threads	-----	ANSI/ASME B1.20.1
Grooved-end Couplings	A536, Gr 65-45-12	------

2.02 FINISH

A. Pipe and fittings 1/4 inch through 12 inch shall have a No. 2D finish or better unless otherwise specified.

2.03 ARCHED BAND COULPLINGS

A. Restrained and expansion arched band couplings 2 inch through 24 inch shall be as manufactured by Victaulic “Depend-O-Lok”, or equal.

B. Couplings shall be suitable for the same working pressure as that of the flanges specified for the piping system in which they are installed.

C. Couplings shall be bolted, split-sleeve type and shall consist of 4 component groups; one-piece housing, gaskets, bolts and nuts, and pipe end rings as required for pipe restraint.

D. Housing shall be manufactured from the same alloy as the pipe and of the thickness required for coupling working pressure.

E. Pipe end rings shall be manufactured by the coupling manufacturer of the same alloy as the pipe and of the dimensions required for coupling working pressure. Coupling manufacturer shall specify welding dimensions and procedures to be used by the pipe fabricator for welding the rings to the pipe.

F. Gaskets shall be EPDM. Bolts and nuts shall comply with the pipe component specification.

G. Expansion couplings shall be of sufficient width to accommodate 1.5 inches of axial pipe movement. Expansion couplings shall be located as shown on the Drawings. One end of each expansion coupling shall be located by pipe end rings.

2.04 UNIONS

A. Stainless steel unions for piping 2 inch and below shall be Uniseal Pipe Coupling as manufactured by CPC-Cryolab, or equal.

B. The pressure rating of unions shall exceed that of the flanges specified for the piping system in which they are installed.

C. Unions shall be manufactured from the same alloy as the pipe and shall be joined to the pipe by the methods specified for fittings for the piping system in which they are installed.

D. Unions shall utilize a resilient, replaceable gasket to provide a leak-tight joint between the union ends. Gaskets shall be of PTFE/metal composite construction suitable for the piping system fluid service.

PART 3 -- EXECUTION

3.01 INSTALLING FLANGED PIPING

A. Set pipe with the flange bolt-holes straddling the pipe's horizontal and vertical centerline. springing, forcing, or stressing the connecting valves or equipment. Install pipe without pipe or any springing, forcing, or stressing the pipe or any adjacent connecting valves or equipment. Avoid extra joints.

B. Lubricate bolts with graphite and oil prior to installation.

3.02 INSTALLING UNIONS

A. Provide unions on exposed piping 2 inches and smaller as follows:

1. At every change in direction (horizontal and vertical).

2. Six to 12 inches downstream of valves.

3. Every 40 feet in straight piping runs.

4. Near threaded connections to mechanical equipment.

5. On both sides of threaded control valves and other in-line instruments.

3.03 FABRICATION, ASSEMBLY, AND ERECTION

A. Beveled ends for butt-welding shall conform to ANSI B16.25. Remove slag by chipping or grinding. Beveled ends shall be clean of paint, oil, rust, scale, slag, and other material detrimental to welding.

B. Fabrication shall comply with ANSI B31.3, Chapter V.

C. All welding of pipe, fittings and subassemblies shall be performed in the factory by qualified welders in accordance with ANSI B31.3 with standard procedures for the application.

D. The minimum number of passes for welded joints shall be as follows:

Steel Cylinder Thickness (inch)	Minimum Number of Passes for Welds
Less than 0.1875	1
0.1875 through 0.25	2
Greater than 0.25	3

E. Use the shielded metal arc welding (SMAW) or the tungsten inert gas (TIG) process for welding. Use the SMAW process for any pipe. Use the TIG process only on pipe having a maximum thickness of Schedule 10S.

F. Welding preparation shall comply with ANSI B31.3, paragraph 328.4. Limitations on imperfections in welds shall conform to the requirements in ANSI B31.3, Tables 341.3.2A and 341.3.2B, and paragraph 341.4 for visual examination.

G. Identify welds in accordance with ANSI B31.3, paragraph 328.5.

H. Clean each layer of deposited weld metal prior to depositing the next layer of weld metal, including the final pass, by a power-driven wire brush. All heat tint resulting from the welding operation shall be removed accordingly.

I. Welding electrodes shall comply with AWS AS.4. Bare wire shall comply with AWS A5.9.

J. At no time shall water be left standing inside completed pipe runs (except during testing after which the line shall be drained). Drain taps with valves shall be provided at all low points in piping systems.

3.04 ACID TREATMENT OF STAINLESS STEEL PIPE AND FITTINGS

A. After all fabrication is completed, all pipe spools shall be pickled and passivated by complete immersion in accordance to ASTM A-380. Alternative methods will not be allowed. All pipe spools shall be free of surface iron and have a uniform finish throughout upon completion of the process.

3.05 HYDROSTATIC TESTING

A. See the Section entitled “Pipeline Testing and Disinfection.” Test with potable water only.

3.06 INSTALLING ABOVEGROUND PIPE

A. Install pipe without springing, forcing, or stressing the pipe or any adjacent connecting valves or equipment.

B. Provide pipe hangers and supports as specified in Division 15.

- END OF SECTION -

SECTION 15020 – PIPE SUPPORTS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. The CONTRACTOR shall provide all tools, supplies, materials, equipment, and all labor necessary for the furnishing, construction, and installation of all pipe supports, hangers, guides, and anchors shown, specified, or required for a complete and operable piping system, in accordance with the requirements of the Contract Documents.

B. Where pipe supports are specifically shown and/or detailed on the drawings, they shall supersede the requirements of this Section.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Piping, General

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Commercial Standards:

ANSI / ASME B31.3	Process Piping
ANSI / ASME B31.1	Power Piping

1.04 CONTRACTOR SUBMITTALS

A. Shop Drawings: The CONTRACTOR shall furnish complete shop drawings of all pipe supports, hangers, anchors, and guides, as well as calculations for special supports and anchors, in accordance with the Section, entitled “Submittals”.

PART 2 -- PRODUCTS

2.01 GENERAL REQUIREMENTS

A. The CONTRACTOR shall note that all pipe support locations are not shown on the Drawings and shall follow the Specifications herein in locating supports. Where deviations and modifications are required, they shall be made subject to review by the ENGINEER.

B. Code Compliance: All piping systems and pipe connections to equipment shall be properly supported, to prevent undue deflection, vibration, and stresses on piping, equipment and structures. All supports and parts thereof shall conform to the requirements of ANSI/ASME B31.1 and ANSI / ASME B31.3, except as supplemented or modified by these Specifications. Supports for plumbing piping shall be in accordance with the latest edition of the applicable plumbing code, or local administration requirements.

C. All piping shall be rigidly supported from the building structure by approved hangers, inserts, or supports. No piping shall be supported from other piping or from metal stairs, ladders, and walkways unless specifically permitted by the ENGINEER.

D. Unless otherwise indicated on the Contract Drawings, piping supports shall consist of concrete piers or fabricated Type 316 Stainless Steel supports as specified below. Materials and workmanship shall be in full compliance with Division 3 - Concrete and Division 5 – Metals of these Specifications.

E. Supporting appurtenances shall be arranged to prevent undue stress on equipment to which piping is connected. Supporting appurtenances shall provide the desired pitch as specified or required for proper drainage of the piping. The pipe suspension shall prevent excessive stress, excessive variation in supporting force, and possible resonance with imposed vibration while the system is in operation. All valves and valve operators shall be rigidly supported independently of the piping. Vertical runs of pipe shall be supported independently of the connected horizontal runs. All vertical pipes shall be supported at each floor or at intervals of at least 10 feet by approved pipe collars, clamps, brackets or wall rests. Supporting appurtenances, when used with copper piping, shall be copper, bronze or bronze plated. All piping shall be supported independently of the equipment to which it is connected. All in line devices (flowmeters, etc.) shall be removable without the need for temporary supports for adjacent and connecting piping.

F. In general, the type of pipe supports to be used shall be as follows unless otherwise shown on the Drawings:

Height of Centerline of Pipe above Floor	Type of Pipe	Type of Support
3 feet or less	Plastic	Metal Framing System
3 feet or less	Metal	Concrete Pier
Greater than 6 feet	All	Adjustable Pipe Saddle, Bracket Supports or Hangers

G. Wall bracket supports shall be used where shown for pipe to be installed adjacent to a wall. Where it is not feasible to install hanger supports, adjustable pipe saddle supports may be used upon review and acceptance by the ENGINEER. The CONTRACTOR shall install pipe supports in conformance with these Specifications unless otherwise shown on the Contract Drawings. Where deviations and modifications are required, they shall be made only with the permission of the ENGINEER. A detailed layout of pipe supports for each building shall be submitted to the ENGINEER for review prior to pipe fabrication or installation.

H. For all couplings, supports shall be placed on each side and as close to the coupling as possible.

I. Structural Members: Wherever possible, pipes shall be attached to structural members. Where it is necessary to frame structural members between existing members, such supplementary members shall be provided by the CONTRACTOR at no additional cost to the OWNER. All supplementary members shall be in accordance with the requirements of the building code and the American Institute of Steel Construction. Stainless steel and non-metallic piping installed in tanks, channels or conduits shall be supported by hangers, hanger rods, hardware and inserts fabricated of Type 316 stainless steel.

J. Freestanding pipe connections to equipment shall be firmly attached to fabricated Type 316 stainless steel frames made of angles, channels, or I-beams anchored to the structure. Exterior, freestanding overhead piping shall be supported on fabricated Type 316 stainless

steel pipe stands, consisting of pipe columns anchored to concrete footings, with horizontal, welded steel angles and U-bolts or clamps, securing the pipes. All materials shall be Type 316 stainless steel.

K. Point Loads: Any meters, valves, heavy equipment, and other point loads on PVC, fiber glass, and other plastic pipes, shall be supported on both sides, according to manufacturer's recommendations to avoid undue pipe stresses and failures. To avoid point loads, all supports on plastic and fiber glass piping shall be equipped with extra wide pipe saddles or galvanized steel shields.

L. Noise Reduction: To reduce transmission of noise in piping systems, all copper tubes in buildings and structures shall be wrapped with a 2-inch wide strip of rubber fabric or similar, suitable material, at each pipe support, bracket, clip, or hanger.

M. Where a specific pipe support is called for on the Drawings, this support shall be used as and where indicated for the specific application. In general, spacing of supports shall be as specified herein unless specifically modified by the ENGINEER.

N. All supports, saddles, bearing plates, and hangers, shall support by direct contact the pipe a minimum of 120 degrees around, except as specified herein.

O. Where continuous concrete inserts are used, the maximum concentrated load on the end two (2) inches of inserts, with laying lengths of eight (8) inches or longer, shall not be more than 50 percent of the maximum recommended loading of the channel. All pipe supports shall be positioned such that they will not interfere with the use of hoisting equipment, where provided.

P. Wherever expansion and contraction of piping is expected, a sufficient number of expansion loops or joints shall be provided, together with the necessary rolling or sliding supports, anchors, guides, pivots, and restraints. They shall permit the piping to expand and contract freely in directions away from the anchored points and shall be structurally suitable to withstand all loads imposed. Pipes subject to thermal expansion shall be installed perfectly aligned and concentrically guided. These piping support systems shall be submitted to the ENGINEER for review. The submittal shall show location of anchors, concentric pipe guides and expansion couplings (single or double).

2.02 TYPE 316 STAINLESS STEEL CHANNEL SUPPORTS

A. Pipe supports shall be wall or slab mounted 1 5/8-inch X 1 5/8-inch UNISTRUT (or equal) Type 316 stainless steel channels with Type 316 stainless steel straps, and Type 316 stainless steel lock nuts. Supports shall be attached to walls and slabs by 3/8-inch diameter, 6-inch long Type 316 stainless steel anchor bolts with lock nuts. Bolt support spacing shall be maximum 12-inch O.C.

2.03 PIPE ROLLER SUPPORTS

A. The CONTRACTOR shall furnish and install self-lubricating roller supports where shown on the Contract Drawings and as specified herein. Roller supports shall be Anvil Figure No. 271 or equal. Assemblies shall include all directly connected or welded anchorage hardware.

B. Roller supports shall meet the loading requirements of the design and conforming to the details on the Drawings. The rollers shall have support section fabricated of the same material as is the pipe to be supported, a Type 316 series stainless steel slide plate, and a

carbon steel base to which the Teflon is applied. The support plates at roller supports shall be stitch welded to stainless steel pipe at all roller support locations.

C. The roller supports shall be installed in the exact locations shown or indicated on the Contract Drawings, at required elevations, true to orientation and level, assuring that the correct half of each roller is in its proper position. The CONTRACTOR shall store the rollers to protect them from mechanical damage prior to installation, and shall protect the same during and after installation from contamination and damage due to placing of concrete and other materials. The CONTRACTOR shall clean the operation surfaces of rollers thoroughly before final assembly.

2.04 SPRING TYPE HANGERS

A. Spring-type pipe hangers shall be provided for piping subject to vibration or vertical expansion and contraction, such as engine exhausts and similar piping. All spring-type hangers shall be sized to the manufacturer's printed recommendations and the loading conditions encountered. Variable spring supports shall be provided with means to limit misalignment, buckling, eccentric loading, or to prevent overstressing of the spring, and with means to indicate at all times the compression of the spring. The support shall be designed for a maximum variation in supporting effort of 25 percent for the total travel resulting from thermal movement.

2.05 PIPE SUPPORT SPACING

A. The distance between supports for each size of pipe shall not exceed those listed in the attached schedule. However, if the pipe size to be supported is not listed in the schedule, the next smaller nominal pipe size spacing shall be used. In all cases, there shall be a minimum of one support per laying length of pipe on uninterrupted horizontal runs. This support shall be placed within one (1) foot of the joint. If the pipe manufacturer recommends a smaller spacing interval than specified herein, then the manufacturer's spacing shall be used.

B. The distance between supports shall not exceed that listed in the following schedule unless otherwise indicated on the Contract Drawings:

Nominal Pipe Size (inches)	Metallic Piping (feet)	Plastic, Fiberglass and Copper Piping (feet)
1/2	5	3
3/4 to 1-1/2	6	3
2 to 3	6	4
4	10	5
6 and larger	10	6

2.06 PIPE HANGERS AND HANGER RODS

A. Where pipe hangers are used, they shall be of the clevis or friction clamp type except where there is longitudinal movement due to temperature changes. Where longitudinal movement occurs, the adjustable yoke roller type hanger shall be used. See the hanger schedule below for location/type of hangers to be used. Pipe hangers shall be capable of supporting the pipe in all conditions of operation. They shall allow free expansion and contraction of

the piping, and prevent excessive stress resulting from transferred weight being induced into the pipe or connected equipment.

B. All hangers shall have a means of vertical adjustment after erection. Hangers shall be designed so that they cannot become disengaged by any movement of the supported pipe. Hangers subject to shock, or thrust imposed by the actuation of safety valves, shall include hydraulic shock suppressors.

C. Hangers shall be designed so that they can not become disengaged by movements of the supported pipe. Lock nuts shall be used on all hangers. All piping systems shall be supported by means of hangers having an individual means of vertical adjustment for leveling of lines after piping is in place.

D. Spacing and arrangements shall conform to the requirements of Section 6, Chapter 1 of ANSI B31-1 code for pressure piping. Spacing indicated shall be the maximum spacing.

E. Hanger rods shall be subject to tensile loading only. At hanger locations where lateral or axial movement is anticipated, suitable linkage shall be provided to permit swing. Stainless steel hangers required in the pipe hanger schedule shall be supported by hanger rods, hardware and inserts fabricated of Type 316 stainless steel.

F. All other rods, hardware and inserts shall be fabricated of hot-dip galvanized steel. At hanger locations where lateral or axial movement is anticipated, suitable linkage shall be provided to permit such movement. Where horizontal pipe movement is greater than ½-inch, or where the hanger rod deflection from the vertical is greater than 4 degrees from the cold to the hot position of the pipe, the hanger rod and structural attachment shall be offset in such a manner that the rod is vertical in the hot position.

G. All concrete inserts and/or expansion bolts shall be capable of supporting the maximum working load of the rod which is attached to it.

H. Sheet metal insulation protector saddle shall be used for all hot water piping, refrigerant piping, etc.

I. A neoprene isolation pad shall be provided between galvanized clevis and stainless steel piping. For hot air applications, a Teflon pad shall be provided.

2.07 SADDLES

A. Pipe saddles shall be used to cradle horizontal piping when being supported from below except where expansion of pipe requires rollers. All saddles shall be capable of being adjusted after installation.

2.08 BASE ELBOWS, TEES AND CONCRETE PEDESTALS

A. Base elbows, tees and concrete pedestals shall be provided at the locations shown on the Drawings and as specified. All vertical runs of pipe shall be supported on a base elbow and/or concrete pedestal. After completion of curing of the concrete pedestal, the piping shall be adjusted to the proper grade.

2.09 HARNESSED PIPE SUPPORTS

A. Pipe harness straps shall be provided on concrete pedestal supports where shown on the Drawings and required by these Specifications.

B. Harness straps shall be 1/4-inch thick, Type 316 stainless steel and attached to the concrete pedestal supports by stainless steel anchors.

C. Unless otherwise indicated on the Contract Drawings, strap width shall be in accordance with the Table below:

Pipe Diameter	Strap Width
4 inches and below	2 inches
6 inches and above	3 inches

2.10 METAL FRAMING SYSTEMS

A. A metal framing system as manufactured by Unistrut, Globe-Strut or approved equal may be used for supporting the piping system. The metal framing system shall be designed and installed according to manufacturer's recommended procedure and shall be capable of supporting the piping system as specified herein.

B. Channels, inserts and closure strips shall be cold formed mild steel conforming to ASTM A-245.

C. Fittings shall be Hot Rolled Steel conforming to ASTM A-307. Fasteners shall conform to ASTM A-307. All pieces shall be hot-dip galvanized after fabrication, unless otherwise noted on the Drawings.

2.11 PLASTIC PIPE SUPPORTS

A. All pipe supports that will be used with plastic pipe shall be provided with a bearing plate where the width of hanger is less one-half (½) of the supported pipe's diameter. The bearing plate must provide bearing 180 degrees around and shall have a minimum laying length of ½ the pipe diameter or three (3) inches minimum. The bearing plates shall be rigid, corrosion resistant and not subject to long term plastic flow properties. To assure one hundred (100) percent bearing, the pipe shall be seated on a filler. This material shall be compatible for use with the pipe. Clamps to be used with plastic pipe shall be fitted snug and shall not exert clamp pressure on the pipe.

2.12 THRUST RESTRAINT

A. Pipe anchors shall be spaced to divide pipe into sections. Anchors shall be located at valves, changes in direction of piping, and major branch connections. Anchors shall be of a type recommended by the pipe manufacturer and reviewed by the ENGINEER.

B. On all piping, where sleeve type couplings and flanged adapters are located near fittings or valves, tie rods shall span across the coupling as specified herein to restrain movements of the pipe along its axial direction. Such restraints can be deleted if both ends of the pipe are anchored in a concrete structure with no fitting or valve occurring within the span length, in the suction piping to a pump where the coupling is between the pump and valve, or when the water pressure measured at the crown of the pipe is less than five (5) feet.

C. All sleeve type couplings shall be harnessed except where noted. The harnessing shall be as shown on the drawings or as specified herein. Harnesses for steel pipe shall be in accordance with AWWA Manual M11 for the pipe size and pressure, working or test whichever is greater.

D. Harnesses shall be tie rods spanning between adjacent flanges. Friction clamps shall not be permitted. The size and number of tie rods shall be the same as for steel pipe for the same pressure and pipe size.

E. Where the distance between adjacent flanges is in excess of ten (10) feet or where a harness can not be used, the pipe supports adjacent to the coupling shall restrain the piping preventing any linear or angular movement resulting in the pipe separating from the coupling or misalignment in the joint.

F. Where expansion joints are used, control units shall be provided. All tie rods and control units shall be installed in accordance with the manufacturer's recommended procedures.

G. Tie rods and associated hardware shall be Type 316 stainless steel.

H. In general, all valves and fittings shall be restrained in an approved manner such that the unbalanced force developed at them shall be supported independent of the piping system.

2.13 MANUFACTURED SUPPORTS

A. Stock Parts: Where not specifically shown or detailed, designs, generally accepted as exemplifying good engineering practice, using stock or production parts, shall be utilized wherever possible. Such parts shall be locally available, new, of best commercial quality, designed and rated for the intended purpose.

B. Suppliers or equal:

1. Basic Engineers, Pittsburgh, PA;

2. Bergen-Paterson Corp., Boston, MA;

3. Elcen Metal Products Company, Franklin Park, IL;

4. Anvil International, Inc., Portsmouth, NH;

5. NPS Industries, Inc., Secaucus, NJ;

6. Unistrut Corp., Itasca, IL.

2.14 COATING

A. Galvanizing: All fabricated pipe supports, other than stainless steel or non-ferrous supports, shall be blast cleaned after fabrication and hot-dip galvanized in accordance with ASTM A123.

PART 3 -- EXECUTION

3.01 INSTALLATION

A. General: All pipe supports, hangers, brackets, anchors, guides, and inserts shall be fabricated and installed in accordance with the manufacturer's printed instructions and ANSI/ASME B31.1 and ANSI / ASME B31.3. All concrete inserts for pipe hangers and supports shall be coordinated with the formwork.

B. Appearance: Pipe supports and hangers shall be positioned in such a way as to produce an orderly, neat piping system. All hanger rods shall be vertical, without offsets. Hangers

shall be adjusted to line up groups of pipes at the proper grade for drainage and venting, as close to ceilings or roofs as possible, without interference with other Work.

C. Pipe Support Spacing: The distance between supports for each size of pipe shall not exceed those specified in paragraph 2.05.

3.02 FABRICATION

A. Quality Control: Pipe hangers and supports shall be fabricated and installed by experienced welders and fitters, using the best welding procedures available. Welding shall conform to the Section entitled “Metal Fabrications”. Fabricated supports shall be neat in appearance without sharp corners, burrs, and edges.

- 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 selected by the CITY, and in accordance with the requirements of Section 09900, entitled “Painting”.

B. In addition to the identification systems specified herein the ENGINEER may order the CONTRACTOR to furnish and install additional identification legends and arrows at no additional cost to the CITY. 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 lettering and color combinations for additional signs shall conform to the requirements specified herein.

1.02 SUBMITTALS

A. The CONTRACTOR shall submit shop drawings and manufacturer’s product literature in accordance with Section 01300 entitled “Submittals” and Section 01600 “Equipment and Materials”.

B. In addition, the CONTRACTOR shall submit with the shop drawings a schedule of the colors and designations proposed for each service. A minimum of four (4) color charts with cross references to the colors and services listed herein shall be included with the Submittal. The CITY shall select the final color for each service during shop drawing review.

PART 2 – PRODUCTS

2.01 PIPING BANDS AND STRIPES

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. Banding colors shall be as indicated in Article 2.03.

B. Buried potable water piping shall be identified by continuous blue stripes in accordance with FDEP 62-555.

2.02 PIPING IDENTIFICATION LETTERING AND ARROWS

A. The CONTRACTOR shall apply identification lettering in the form of plain upper-case block lettering giving the name of the pipe contents and arrows indicating the direction of flow of liquids to all types and sections of piping.

B. All lettering and arrows shall be of the vinyl, self-adhesive tape type or the plastic snap-on/strap-on type with self gripping fasteners. Pipe-marking devices (i.e., tape or snap-on/strap-on type) shall be suitable for a 5 to 8 year outdoor life without discoloration. Pipe marking devices shall be as manufactured by Lab Safety Supply, or equal.

C. Identification lettering and arrows shall be placed as directed by the ENGINEER, but shall generally be located every ten feet and shall be properly inclined to the pipe axis to facilitate easy reading. Lettering shall also appear directly adjacent to each side of any wall or slab the pipeline passes through, with a minimum of two titles on each pipe in one structure. Identification lettering shall be located midway between color coding bands where possible.

D. Lettering, background and arrow colors shall be the manufacturer's standard colors unless otherwise directed by the ENGINEER.

E. All lettering and arrows shall have an overall height in inches in accordance with Table 15030-1.

Table 15030-1
Height of Pipe Lettering

Diameter of Pipe or Pipe Covering	Height of Lettering
3/4 to 1 1/4 inches	1/2 inch
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

F. The manufacturer's instructions shall be followed in respect to storage, surface preparation and application.

G. For piping less than 3/4-inch diameter, the CONTRACTOR shall furnish and attach corrosion resistant color tags with the required lettering.

H. Pipe lettering for each service type shall be as indicated in Article 2.03.

2.03 PIPING AND EQUIPMENT IDENTIFICATION SCHEDULE

A. The CONTRACTOR shall provide the colors selected by the CITY from the painting manufacturer's color charts during shop drawing review.

B. Pipe lettering, pipe base color and band color shall be as indicated in Table 15030-02. The colors referenced are for convenience only. The CONTRACTOR shall provide the colors selected by the CITY from the proposed painting manufacturer <u>custom</u> color charts during shop drawing review.

Table 15030-2
Piping and Equipment Identification Schedule

Service Type	**Lettering**	**<u>Base Color</u>**	**<u>Band Color</u>**
		Color	**Color**

Service Type	Lettering	Base Color	Band Color
		Color	Color
Potable Water	Potable Water	Dark Blue	N/A
Sodium Hypochlorite	Sodium Hypochlorite	Yellow	N/A
Sodium Hydroxide	Sodium Hydroxide	Yellow	Green
Sample	Sample	Color to match service	
Vent	Vent	Buff	N/A

PART 3 -- EXECUTION (NOT USED)

- END OF SECTION -

SECTION 15060 – CPVC PIPE AND FITTINGS

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. This section includes materials, installation, and testing of chlorinated polyvinyl chloride (CPVC) pipe and fittings for use in process piping having a maximum operating pressure of 200 psi at a maximum operating temperature of 105 degrees Fahrenheit and a maximum operating pressure of 100 psi at a temperature of 140 degrees Fahrenheit.

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 Section 01300 “Submittals”.

B. 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. CPVC shall be Class Class 23447-B or better, conforming to specification ASTM D1784 and ASTM F441/F441M.

2.02 NIPPLES

A. Short nipples shall be the same as the CPVC pipe.

2.03 FITTINGS

A. Fittings shall be Schedule 80 and shall conform to ASTM F437 for threaded fittings and ASTM F439 for socket-type fittings. CPVC shall be Class 23447-B or better, conforming to specification ASTM D1784.

2.04 FLANGES

A. CPVC 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. Flange gaskets shall be natural rubber or other material fully compatible with the fluid being conveyed. Where flanged piping is used with chemical systems, the gasket material shall conform to the requirements of the following table.

Chemical	Elastomer Material
Sodium Hydroxide (Caustic)	EPDM
Sodium Hypochlorite	FKM

2.05 UNIONS

A. Union shall have socket-type ends, EPDM o-rings for sodium hydroxide service and Viton o-rings for sodium hypochlorite, and shall be Schedule 80. Material shall be Class 23447-B or better, conforming to specification ASTM D1784.

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 F493 and be NSF listed for potable water. Cement for sodium hypochlorite piping shall be certified by the manufacturer for this application.

C. Manufacturer shall provide written conformance of solvent cement with intended chemical applications.

2.07 BOLTING AND NUTS FOR FLANGES

A. Bolts and nuts for interior flanges shall be carbon steel conforming to ASTM A307, 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 A193, Grade B8M for bolts, and ASTM A194, Grade 8M for nuts. Bolts and nuts larger than 1-1/8 inch shall be steel, ASTM A307, Grade B, with cadmium plating, ASTM A165, Type NS.

C. Provide washers for each nut. Washers shall be of the same material as the nut.

2.08 SECONDARY CONTAINMENT PIPING

A. When called for on the Drawings or listed in the schedules, provide secondary containment piping meeting the following requirements:

1. Pipe material is to match the material of the carrier pipe.

2. Straight runs of pipe are to be equipped with centralizing spiders to hold the carrier pipe securely inside the secondary containment pipe.

3. Fittings are to be modified from injection-molded and/or seamless fittings. All secondary containment fittings shall be prefabricated to house the corresponding primary (carrier) fittings as a subassembly and be fully anchored to the corresponding primary fittings.

4. Joining methods are to be the same as the primary containment pipe.

5. Secondary containment piping is to be Guardian by Ipex, FloSafe, Inc., or equal. Clamshell type secondary containment is not acceptable.

PART 3 – EXECUTION

3.01 GENERAL

A. Do not install CPVC pipe when the temperature is below 40 F or above 90 F. Store loose pipe 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 fluid.

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 CPVC 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 Anti-seize, or equal before installation.

B. Tighten bolts on CPVC 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:

Pipe Size (inches)	Final Torque (foot-pounds)
1/2 to 1-1/2	10 to 15
2 to 4	20 to 30

3.05 THREADED JOINTS

A. Cut threaded ends on CPVC 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 CPVC 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.

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 CPVC pipe in accordance with ASTM D2774 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 02222 "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 15020 "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. Apply protective coating per Section 09900 "Painting".

3.10 HYDROSTATIC TESTING

A. Perform hydrostatic testing for leakage in accordance with requirements set forth in Section 15995 "Pipeline Testing".

- 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 01090, 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 BI.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	Gate Valves for Water and Sewerage Systems.
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, 3 Through 12 NPS, for Water and Sewage Systems.
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 a proper installation and an operating system 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 James B. Clow & Sons, Kennedy Valve Mfg. Co., Charlotte Pipe and Foundry Company, 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.

C. 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.

D. 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.

E. Valve boxes shall be set plumb, and centered with the bodies directly over the valves so that traffic loads are not transmitted to the valve. Earth fill shall be carefully tamped around each valve box to a distance of 4 feet on all sides of the box, or to the undisturbed trench face, if less than 4 feet.

F. 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 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 01300, 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 Section 01300, Submittals.

PART 2 – PRODUCTS

2.01 PLASTIC BALL VALVES

A. Plastic ball valves shall be used at all PVC / CPVC pipe installations where required, and be made of polyvinyl chloride (PVC) or chlorinated polyvinyl chloride (CPVC), polyvinylidene fluoride (PVDF 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 threaded ends or flanged ends to ANSI B 16.5, class 150, for easy removal. Plastic ball valves shall be Regular Style. The balls shall have full size ports and Teflon seats and shall be polished free of any imperfections. Teflon seats shall have elastomeric backing cushion of the same material as the valve seats. All body seals, union O-ring seals, and stem seals shall be Viton except for sodium hydroxide service which shall be EPDM. 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. Plastic ball valves used for sodium hypochlorite service shall be provided with factory drilled vent in the balls. The drilled hole shall be deburred to remove any rough edges that would score the seats if they were not removed. The valves shall be installed so that the vent points upstream when the valve is in the closed position. CONTRACTOR shall coordinate position of each vented valve with ENGINEER prior to installation.

C. Suppliers or Equal

1. ASAHI-America;

2. IPEX;

3. Plast-o-matic.

2.02 BRASS BALL VALVES

A. Unless otherwise specified or shown, general purpose and service air ball valves in sizes up to 4-inch shall have manual operators with lever or handwheel. All ball valves shall be of best commercial quality, heavy duty construction.

B. All ball valves up to 1-1/2-inch (incl.) in size shall have brass 2- or 3-piece bodies with threaded ends for a pressure rating of not less than 300 psi WOG. Valves 2-inch to 4-inch in size shall have brass bodies with flanged ends for a pressure rating of 125 psi or 150 psi.

C. The balls shall be solid brass or stainless steel, with full openings.

D. The valve stems shall be of the blow-out proof design, stainless steel, or other acceptable construction, with reinforced Teflon seal.

E. The valve seats shall be of Teflon or Buna-N, for bi-directional service and easy replacement.

F. Manufacturer or equal

1. Jamesbury Corporation

2. Jenkins Bros.

3. Lunkenheimer Flow Control

4. Wm. Powell Company

2.03 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, "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 check valves, complete and operable, as shown and specified herein, including epoxy coating, appurtenances and accessories, all in accordance with the requirements of the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 15114 – Miscellaneous Valves and Appurtenances

PART 2 -- PRODUCTS

2.01 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 Bl.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. Manufacturers, or equal:

1. Crane Company.

2. Milwaukee Valve Company.

3. Stockham Valves and Fittings.

4. Val-Matic.

5. APCO.

2.02 PVC AND CPVC BALL CHECK VALVES

A. Check valves shall be swing check type or ball check type manufactured from PVC or CPVC compounds. PVC shall comply with ASTM D 1784, 12454B. CPVC shall comply with ASTM D 1784, 23447B. Ball check valves shall be furnished with viton seats, and viton seals as manufactured by Chemtrol Products Division of NIBCO, Inc., or equal for all

chemical service except sodium hydroxide service. Ball check valve seats and seals for sodium hydroxide service shall be EPDM.

B. Ball check valves shall be provided on piping less than 3-inches in diameter. Ball check valves shall be furnished with threaded ends and shall be true union type.

C. Manufacturers, or equal:

1. Asahi-America.

2. George Fischer, Inc.

3. IPEX

4. Nibco, Inc. (GS Chemtrol).

2.03 PLASTIC SWING OR Y-CHECK VALVES

A. General: Plastic swing or Y-check valves for corrosive fluids, in sizes up to 8 inches or as available, may be used for horizontal or vertical up-flow conditions.

B. Construction: The valve bodies and discs or piston shall be of PVC, PP, or PVDF construction, as best suited for each individual service condition. They shall have flanged ends conforming to ANSI/ASME B16.5 – Pipe Flanges and Flanged Fittings, class 150, and flanged top access covers, and they shall shut positively at no-flow conditions. The seats and seals shall be of EPDM, Teflon, or Viton. The PVC valves shall be rated for a maximum non-shock working pressure of 150 psi at 73 degrees F for sizes 3-inch and smaller. For larger sizes and other materials and temperatures the pressure rating will be lower.

C. Manufacturers, or equal:

1. ASAHI – America

2. George Fischer, Inc.

2.04 CHEMICAL TANK OVERFLOW FLANGE INSERT CHECK VALVES

A. Spring loaded check valves shall be provided on the overflow piping of chemical tanks as shown on the Drawings. The valves shall be the same diameter as the overflow line.

B. The valves shall be of the flanged insert, poppet type for installation between mating ANSI Class 150 flanges. Valve materials shall be PTFE with Viton O-ring seats. The springs shall be PTFE encapsulated type 316 stainless steel rated for a cracking pressure of ½ psi.

C. Manufacturer, or equal:

1. Check-All Valve Mfg. Co.

2.05 METAL INTERNAL SPRING-LOADED CHECK VALVES (GLOBE STYLE)

A. General: Internal spring-loaded check valves for water pumps, compressors, gas, air, and steam shall be of the full-flow internal spring-loaded poppet type. The valves shall be designed for a water-working pressure of not less than 150 psi unless otherwise indicated.

B. Body: The bodies of all valves in sizes 3-inch and larger shall be of cast stainless steel conforming to ASTM A 351, Gr. CF8M with Class 150 flanged ends. Where necessary, there shall be a positive, watertight seal between the removable seat and the valve body. The stem guide shall be integrally cast with the body, or screwed into the body.

C. Valves smaller than 3 inches shall have Gr. CF8M stainless steel bodies with screwed ends conforming to ANSI/ASME B 16.34 1.20.1 – Pipe Threads, General Purpose (inch), suitable for a minimum working pressure of 300 psi, unless otherwise shown indicated.

D. Disc and Stem: The disc and stem of all valves in sizes 3-inch and larger shall be of stainless steel conforming to ASTM A 351 Gr. CF8M. The stem shall have two-point bearings. The downstream bearing shall have a bushing, to provide a smooth operation.

E. Valves smaller than 3 inches shall have discs and retaining rings of Teflon, Nylon, or other suitable material, and stems of stainless steel, suitable for the intended service.

F. Stem Guide: The stem guide must be either firmly fixed in the valve body to prevent it from sliding into the adjacent pipe and damaging the pipe lining, or the valve manufacturer shall furnish each valve with one matching flange compatible with the adjacent pipe and its lining to prevent damage to the lining. The compatible flange shall be part of the shop drawing submittal.

G. Seat: All valves for general service at temperatures up to 250 degrees F shall have bubble-tight shut-off with resilient seats of Buna-N, Teflon, or other suitable material. Valves for steam service and temperatures over 250 degrees F shall have metal-to-metal seating stainless steel, as recommended by the manufacturer for the specific service condition. All resilient seats shall be firmly attached to the seating ring by compression-molding or other acceptable method.

H. Spring: All valves in sizes 3-inch and larger shall have Type 316 stainless steel springs, and valves smaller than 3-inch shall have stainless steel springs, as suitable for the service. The spring tension of the valves shall be designed for the individual pressure condition of each valve. Cracking pressure shall be ½ psi unless otherwise specified.

I. Manufacturers, or equal:

1. APCO (Valve and Primer Corp.)

2. Mueller Steam Specialty

3. VAL-MATIC (Valve and Manufacturing Corporation)

PART 3 -- EXECUTION

3.01 GENERAL

A. All valves shall be installed in accordance with provisions of Section entitled “Miscellaneous Valves and Appurtenances”.

B. All valve exteriors shall be painted as specified in the Section entitled "Painting." All exposed interior corrosive ferrous surfaces of valves 4 inches and larger shall receive a fusion bonded epoxy coating conforming to AWWA C550.

- 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 HOSE BIBBS

A. Potable Water System: Hose bibbs shall be 3/4-inch brass, rough chrome plated, with vacuum breaker and loose key stop. Hose bibbs shall be Chicago No. 998, Sloan or equal

B. Reuse Water System: Hose bibbs shall be 1-inch bronze body angle valves with screwed inlet, hose outlet, quick connect coupling, cap and chain. Hose bibs shall have a minimum 200 psi nonshock, cold water pressure rating. Bibbs shall be, Crane o. 117, Walworth or equal.

C. Tags: Provide permanent, plastic or brass name tags located above the bibbs which shall state either “POTABLE” or “REUSE WATER – DO NOT DRINK” as required. Letters shall be approximately ¾-inch high.

2.02 BACKFLOW PREVENTERS (1/2-INCH THROUGH 10-INCH)

A. Backflow preventers shall be of the reduced pressure assembly type and shall contain two spring loaded check valves and one spring loaded, diaphragm actuated, differential pressure relief valve. The unit shall include tightly closing shut-off valves located at each end of the device and shall be fitted with properly located test cocks. Operation shall be completely automatic. All parts shall be removable or replaceable without removal of the unit from the line. All materials shall be protected against corrosion. Backflow preventers ½ to 2-inch shall be as manufactured by Watts Model LF919 or Wilkins Model 975XL2, or equal. Backflow preventers 2-½ to 10-inch shall be as manufactured by Watts Model 957 or 994, or Wilkins Model 375, or equal.

2.03 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.

2.04 CORPORATION STOPS

A. Corporation stops shall be provided with all service saddle connections with IPS threads. 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.

2.05 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.

2.06 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.

2.07 MUD VALVES

A. Mud valves shall be cast iron body with bronze stem, stem nut, disc ring, and seat ring. Bolts and nuts shall be corrosion resistant. Mud valve shall be flanged with non-rising stem. Mud valve shall be Model F-3075 as manufactured by Clow, or equal.

2.08 QUICK COUPLINGS AND DUST CAPS

A. Quick couplings and dust caps shall be provided for all fill station connections and where shown on the Drawings or specified. Quick couplings shall be manufactured to the dimensional specifications of the new Federal Standard A-A-59326 for compatibility with couplings of other manufacturers and delivery hose systems. Insulating type fittings or Teflon tape shall be provided to prevent galvanic action between dissimilar metals. Couplings shall be as manufactured by Total Control Systems type Polypropylene Kamlok model 633-B (male) or equal, for sodium hypochlorite and sodium hydroxide. Dust caps shall be MEK 634B for sodium hypochlorite and sodium hydroxide. A 1/16-inch vent opening shall be frilled in each dust cap to prevent pressurization of the cap. Each dusk cap shall be provided with a key lock mechanism with a distinct key for each connection. Coupling and dust cap materials shall be as scheduled below:

Service	**Coupling**	**Cap**
Sodium Hypochlorite	CPVC	CPVC
Sodium Hydroxide	Polypropylene	Polypropylene

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 15095 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) Restrained (Buried)	53 51	(1)
Less than 4-in	PVC / CPVC	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.

1.02 PIPING SCHEDULE ABBREVIATIONS

The following abbreviations are used in the schedule:

1. Service

CA - Compressed Instrument Air Supply Piping

DRAIN - Drain

FRP - Fiberglass Reinforced Plastic Ductwork

MW - Softened Water to Scrubber

NPW - Non-Potable Water

PW - Potable Water

SAMPLE - Sample

SCP - Secondary Containment Pipe

NaOCl - Sodium Hypochlorite

NaOH - Sodium Hydroxide

RECIRC – Recirculation

Vent - Vent

2. Material:

CPVC - Chlorinated Polyvinyl Chloride

CSP - Carbon Steel Pipe

Cu - Copper

DIP - Ductile Iron Pipe

HDPE - High Density Polyethylene

SS - 316L Stainless Steel

PVC - Polyvinylchloride

PVDF - Polyvinylidene Fluoride

3. Wall Thickness:

CL - Class

DR - Diameter Ratio

Sch - Schedule

SDR - Standard Diameter Ratio

4. Joint Type:

CJ -Compression Joint

Flg -Flanged

Grvd -Grooved

PO -Push on Joint

RJ -Restrained Joint

SW -Solvent Welded

Thd -Threaded

Wld -Welded

Sld -Soldered

FW -Fusion Welded

5. Fitting Type:

SS -316 Stainless Steel (nonwelded joints)

CU -Copper

DI -Ductile Iron

PVC -Polyvinylchloride

CPVC -Chlorinated Polyvinylchloride

HDPE -High Density Polyethylene

6. Interior Surface Protection:

ACCL -Asphalt Coated Cement Lined

EL -Epoxy Lined

GL -Glass Lined

CML -Cement Mortar Lined

7. Exterior Surface Protective Coating:

AC -Asphalt Coated (below ground only)

P -Painted (above ground only)

8. Valve Type:

ARV -Air Release Valve

PLG -Eccentric Plug

9. Body Type:

CPVC -Chlorinated Polyvinylchloride

SS -316 Stainless Steel

OS&Y -Outside Screw & Yoke

NRS -Non-rising Stem

1.03 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 Section 11000, “Equipment General Provisions,” and Section 01300, “Submittals”. All valves shall be tagged by the manufacturer according to the control valve designations listed in the Schedule.

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)

PIPING SCHEDULE

System	Nominal Pipe Diameter (inches)	Material	Thickness Class or Schedule	Test Pressure (PSIG)	Type of Joints	Type of Fittings	Protective Coating		Remarks
							Interior	Exterior	
CA (High Pressure)	All	316L SS	SCH 40	175	Thd or Welded	316L SS	--	--	Note 3
DRAIN	All	PVC	Sch 80	Gravity	See Note 1	PVC	--	--	
FRP	10	FRP	See Note 5	NA	Butt Joint/Flg		--	--	
MW	All	CPVC	Sch 80	150	SW	CPVC	--	--	Note 4
PW / NPW	Under 4	PVC	Sch 80	150	SW	PVC	--	--	Note 2
NaOCl	All	CPVC	Sch 80	150	Flg or SW	CPVC		P	Note 4
NaOH	All	CPVC	Sch 80	150	Flg or SW	CPVC		P	Note 4
RECIRC	All	CPVC	Sch 80	150	SW	CPVC	--	--	Note 4
SAMPLE	All	CPVC	Sch 80	150	SW	CPVC	--	--	Note 4
SECONDARY CONTAINMENT	3	PVC	Sch 40	5	SW	PVC	--	--	Note 2,6
VENT	All	PVC	Sch 80	NA	Flg or SW	PVC	--	--	Note 2

Notes:

1 Refer to Section 15008, “SMALL PVC NON_PRESSURE PIPE”
2 Refer to Section 15009, “PVC PRESSURE PIPE”
3 Refer to Section 15013, “STAINLESS STEEL PIPE”
4 Refer to Section 15060, “CPVC Pipe and Fittings”
5 Refer to Section 13252, “FRP DUCTWORK”
6 Secondary Containment required outside of containment area as shown on Drawings

Valve Schedule

System	Service/Piping	Valve Type	Body Type	Ends	Size (inches)	Cold Pressure Rating (psi)	Spec No.	Notes
NaOCl	General/CPVC	Ball	CPVC	Union/SW	½ - 4	150	15104	
	General/CPVC	Check	CPVC Ball	Union/SW	½ - 4	150	15105	
	Tank Isolation	Ball	CPVC	Union / 150 Flg	1 - 3	275	15104	
	Tank Outlet	Ball	CPVC	Flg	½ - 3	150	15104	
	Tank Overflow	Check	PTFE	Wafer	2 - 3	20	15105	
NaOH	General/CPVC	Ball	CPVC	Union/SW	½ - 4	150	15104	
	General/CPVC	Check	CPVC Ball	Union	½ - 4	150	15105	
	Tank Isolation	Ball	CPVC	Union / 150 Flg	½ - 3	150	15104	
	Tank Outlet	Ball	CPVC	Flg	½ - 3	150	15104	
	Tank Overflow	Check	PTFE	Wafer	2 – 3	20	15105	

Notes:

1. This schedule is provided for the Contractor's convenience; it shall be the Contractor's responsibility to review all contract drawings and specifications and provide all valves identified elsewhere in the overall Contract Documents.

- END OF SECTION -

SECTION 15596 – FRP DUCTWORK

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish, install, test, adjust, and place in satisfactory operation fiberglass reinforced plastic (FRP) odor control ductwork, fittings, dampers, expansion joints, supports, and appurtenances for odor control service in accordance with the requirements of the Contract Documents.

B. The Contractor shall have unit responsibility for the correct furnishing, installation, inspection, and testing of the equipment specified herein.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Division 01 – General Requirements

B. Section 11000 – Equipment General Provisions

C. Section 13253 – Modular Odor Control Scrubber

D. Section 15020 – Pipe Supports

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Equipment and appurtenances shall conform to, but not be limited to, the following standards:

1. ASTM C582 – Standard Specification for Contact-Molded Reinforced Thermosetting Plastic Laminates for Corrosion-Resistant Equipment.

2. ASTM D2583 – Standard Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor.

3. ASTM D 2996 – Standard Specification for Filament-Wound “Fiberglass” (Glass-Fiber-Reinforced-Thermosetting-Resin) Pipe.

4. ASTM D3299 - Standard Specification for Filament-Wound Glass-Fiber-Reinforced Thermoset Resin Corrosion-Resistant Tanks.

5. ASTM D 3567 – Standard Practice for Determining Dimensionsuppors of “Fiberglass” (Glass-Fiber Reinforced-Thermosetting-Resin) Pipe and Fittings.

6. ASTM D 3982 – Standard Specification for Contact Molded “Fiberglass” (Glass Fiber Reinforced Thermosetting Resin) Duct. and Hoods.

7. NBS PS 15-69 – Custom Contact-Molded Reinforced Polyester Chemical-Resistant Process Equipment.

B. Other Associated Standards:

1. Florida Building Code, latest edition.

2. National Fire Protection Agency No. 91.

3. Air Movement and Control Association, Inc. (AMCA).

4. American Society of Mechanical Engineers.

1.04 SUBMITTALS

A Shop Drawings:

1. In accordance with the procedures and requirements set forth in Section 01300 - Submittals, the Contractor shall submit for review design data and detailed shop drawings. The shop drawings shall include but not be limited to the following:

a. Certificate for the ducts listing the resin to be used, its composition, fabrication information, that it has been tested in accordance with ASTM Standards and that the resin for the ductwork is compatible with an environment consisting of warm moisture-laden air with hydrogen sulfide, mercaptans and other organic and inorganic compounds typically associated with wastewater treatment.

b. Dimensioned duct layout showing locations of supports, hangers, anchors, guides and expansion joints, sealed by a Professional Engineer licensed in the State of Florida. The Professional Engineer shall determine the locations required for any supports not detailed on the Contract Drawings, the type of support necessary for that location, and the locations of expansion joints.

c. Cut sheets, dimensions, and materials information for duct, fittings, dampers, expansion joints, and appurtenances.

d. Ductwork thicknesses, flange thicknesses, and recommended bolting torque values for flanged joints.

e. Dampers: Submit manufacturer's product data (materials, construction, dimensions, and installation details), including leakage, pressure drop, and maximum pressure data in accordance with AMCA 500 testing. Submit data for full range of damper sizes provided.

f. Design calculations, signed and sealed by a registered Florida Professional Engineer, shall be submitted showing that the ductwork thicknesses meet the Florida Building Code.

g. Detailed shipping, storage, and installation instructions.

h. Joint fabrication details.

i. Field joint hand layup procedures and details.

j. Shop testing procedure.

k. Visual inspection checklist.

l. Field testing data per paragraph 3.03.

1.05 MANUFACTURERS AND INSTALLERS

A. The materials covered by the Contract Documents are intended to be standard equipment of proven reliability and as manufactured by reputable manufacturers having experience in the production of such equipment.

B. Manufacturers shall have experience in the manufacture of this type of equipment in accordance with Section 11000 entitled "Equipment General Provisions". It shall be the responsibility of the Contractor to demonstrate that the equipment meets the specified performance requirements and to meet all quality assurance requirements as specified in Section 11000 entitled "Equipment General Provisions".

C. The Manufacturer shall be responsible for design of the ductwork system, including, but not limited to the FRP ductwork, shear collars, dampers, expansion joints, piping supports not detailed on the Contract Drawings, and other appurtenances for a complete and functioning system. This specification is intended to provide minimum standards only and the final design shall be the responsibility of the Manufacturer.

D. Both the Manufacturer and the installer shall demonstrate experience on at least 5 projects requiring similar fabrication and installation methods.

E. Design shall include all vertical and lateral loads on the ductwork in accordance with the Florida Building Code, latest edition, and shall consider the geometry of the ductwork and location of supports as shown in the Contract Drawings.

1.06 GUARANTEES, WARRANTIES

A. The Contractor shall provide any guarantees and warranties in accordance with Section 11000 entitled "Equipment General Provisions".

1.08 PRODUCT DELIVERY, STORAGE AND HANDLING

A. The Contractor shall be responsible for the delivery storage and handling of the equipment as specified in Section 11000 entitled "Equipment General Provisions".

B. Ends of ductwork shall be protected for shipment. Flange gasket faces shall have flange protectors. The inside of all ductwork shall be dry and free of foreign objects that could cause damage. All threaded fittings or openings shall be plugged or capped. All loose parts

such as nuts, bolts, gaskets shall be packaged sufficiently to allow storage under field conditions and included in the packaging will be bill of material of contents.

C. The fabricator shall mark pieces or subassemblies to agree with bill of materials and installation drawings.

D. Shipping: Duct shall be bundled and packaged in order to eliminate shifting or movement to the carrier's specification. Fittings and loose parts shall be crated and packed securely to prevent damage in normal handling. The use of chains or cables to tie down loads shall not be permitted. Flat steel strapping is acceptable provided padding is used between it and the pipe to prevent damage. Any evidence of damage during shipping shall be sufficient course for rejection of the damaged piece.

PART 2 – PRODUCTS

2.01 GENERAL

A. Service Conditions:

1. The FRP piping system shall be designed and fabricated for odor control service to carry warm moisture-laden air with hydrogen sulfide, mercaptans and other organic and inorganic compounds typically associated with wastewater treatment.

2. The maximum unsupported spans shall be as follows. Maximum hoop deflection at unsupported span lengths shall be 1% of the duct nominal diameter, including all service loads.

Duct Inside Diameter (Inches)	Maximum Span (Feet)
3 – 14	10

3. Duct wall thickness shall be designed by the Manufacturer to meet the criteria specified in this Section. The minimum wall thickness for all FRP duct shall be the greater of the calculated thickness or the following:

Duct Inside Diameter (Inches)	Wall Thickness (Inches)
3 – 16	0.1875

4. Resin:

a. Resin shall be premium, corrosion-resistant and fire-retardant brominated bisphenol-A vinyl ester. Resin shall not contain pigments, dyes or colorants. Fillers are only permitted for flame retardance. The product shall have a Class 1 flame spread rating (25 or less). The ENGINEER reserves the right to request the CONTRACTOR to submit laminate samples taken from the job site for confirmation that the specified resin was used throughout the laminate.

b. Thixotropic agents can be added to control resin viscosity per resin manufacturer's recommendation.

c. Acceptable resins with no more than 3 percent antimony trioxide shall be:

1) Reichhold Dion 9300 FR.
2) Interplastics CoRezyn 8440.
3) Ashland Chemical Hetron FR992.
4) AOC Vipel K-022
5) Or equal.

5. Reinforcement:

a. Surfacing veil shall be C glass veil with a silane finish and a styrene soluble binder.

b. Chopped strand mat shall be Type E glass minimum 1-1/2 ounces per square foot with silane finish and styrene soluble binder.

c. Continuous roving for chopper gun spray up shall be Type E glass. Chopper gun is only permitted if an automated process is used. Manual operation of chopper gun shall not be permitted.

d. Woven roving shall be Type E glass minimum 24 ounces per square yard with a five by four weave.

e. Continuous roving for filament winding shall be Type E glass with a silane finish.

B. Construction:

1. All FRP ductwork shall be of filament wound or hand lay-up construction.

2. Maximum allowable deflection for any size ductwork shall be ½ inch between supports for any size of duct under worst case design conditions.

3. FRP ductwork shall be designed using a safety factor of 10 to 1 for pressure and 5 to 1 for vacuum. FRP ductwork shall be designed for a maximum vacuum pressure of 16 in. w.c. and a maximum positive pressure of 12 in. w.c.

4. Location: Outside as shown on the Drawings.

5. Ambient temperature: 20 degrees F to 120 degrees F.

6. Wind and Seismic Loads: Meet requirements shown on the structural drawings.

7. Length of all flanged duct sections shall not vary more than ± ½ inch at 70°F.

8. All unflanged duct shall be square on the ends in relation to the center axis within ± 1/8 inch up to and including 24-inch diameter.

9. Laminates:

    a. All ductwork shall have a resin-rich inner surface, an interior corrosion barrier, an interior structural layer and an exterior layer.

    b. Ductwork to meet or exceed requirements of ASTM D3982, ASTM D2996, ASTM D3567, and ASTM C582 or any applicable international standards.

    c. Inner surface: Minimum 20 mils thick composed of a single ply of the Type C glass surfacing veil embedded in a resin rich surface. Resin content shall be 90%.

    d. Interior layer: Minimum of at least two layers of 1 ½ oz per square foot chopped strand mat. Resin content shall be 75%. The combined thickness of the inner surface and interior layer shall be a minimum of 100 mils thick.

    e. Structural layer: Type E glass to meet minimum wall thickness as specified. The total wall thickness includes the inner surface and inner layer. The total wall thickness does not include the exterior layer.

        1) Contact molded structural layer shall include alternate layers of chopped strand mat and woven roving.
        2) Filament wound structural layer shall be preceded by a layer of chopped strand mat or spray chop. The structural layer shall consist of a minimum of three complete cross hatched layers of continuous filaments applied in a helix angle per ASTM D3299.

    f. Exterior layer: Factory applied paraffinated gel coat with UV inhibitors. Pigmentation shall be determined by the City. Pigmentation shall not be added to the exterior layer until visual inspection is completed.

    g. The duct shall have a Barcol hardness of at least 90 percent of the resin manufacturer's minimum specified hardness for the cured resin when tested in accordance with ASTM D2583.

11. Fittings:

    a. All fittings shall be hand-layup construction fabricated from the same resin and having the same strength as the FRP ductwork.

    b. The internal diameter of all fittings shall be equal to the adjacent duct.

    c. The tolerance on angles of all fittings shall be ± 1° up to and including 24-inch diameter and ± ½° for 30-inch diameter and above.

12. Elbows:

a. The centerline radius of all elbows shall be 1-1/2 times the diameter.

b. Elbows 24-inch diameter and smaller shall be smooth radius. Elbows 30 inches and larger shall be mitered. Provide a minimum of two mitered joints for all elbows up to and including 45 degrees and four mitered joints for elbows up to and including 90 degrees.

13. Flanges:

a. Provide flanged connections to dampers, flexible connectors, expansion joints, vessels, demisters, fans, silencers and other locations as shown on the Drawings.

b. Flanges shall be hand lay-up construction, fabricated from the same resin and having the same ratings as the FRP ductwork. Dimensions shall be in accordance with NBS PS 15-69.

c. Flanges shall be drilled in accordance with NBS PS 15-69 Table 2. Flange faces shall be suitable for use with full face gaskets. Backs of bolt holes shall be spot faced for a standard diameter washer.

d. Flange faces shall be perpendicular to the axis of the duct within ½ inch.

e. Flange faces shall be flat to within ± 1/32 inch up to and including 18-inch diameter ducts and flat within ± 1/16 inch for 20-inch diameter ducts and larger.

f. Gaskets shall be EPDM, full face and minimum 1/8-inch thickness.

g. Provide all Type 316 stainless steel bolts, nuts and washers.

14. Joints:

a. Provide all butt and strap joints in accordance with NBS PS 15-69.

b. Field weld kits shall be supplied by the duct manufacturer. All necessary fiberglass and reinforcing material shall be supplied pre-cut and individually packaged for each joint.

c. All resin, catalyst and putty shall be supplied in bulk to complete all field joints plus 25% extra for waste.

15. Provide minimum ¼ inch buildup of FRP over the duct at each duct support location.

C. Inspection:

1. The fabricator shall have established quality control standards and procedures implemented by an established quality control staff. Minimum standards shall be as follows:

a. Reinforced plastic laminates shall be of high quality with no areas that are excessively resin-rich or poorly wetted-out. The laminate shall be dense, without dry spots or cracked or crazed surfaces. Small air bubbles should be evenly distributed. Clusters of large air bubbles in the laminate will be cause for rejection.

b. The outer surface of the laminate shall be smooth and free from exposed glass fibers. All reinforcing fibers exposed by cross-cutting through a section of the laminate must be protected by coating with resin.

c. Each part shall be checked visually without the aid of magnification. Visual examination of a laminate should be made prior to the addition of any colorants or pigments. Inspection should be made by placing a light behind the wall or section of the structure to permit the detection of air bubbles, dry spots, internal cracking, or other conditions that would indicate possible weaknesses in the structure.

d. The edges of sections cut from the fabricated piece at manhole positions, nozzle locations, etc., should be inspected to determine the depth of the resin-rich inner layer and to check the placement and type of structural glass reinforcement.

e. The outside pigment coat shall not be applied until the ends of the lay-up and the edges of the cut-outs have been checked for possible delamination.

f. The plastic laminates exposed to liquid chemicals or corrosive air service should be uniform and free from cracks, holes, blisters, dry spots, chalking and other similar defects. The laminates shall be essentially free of voids or air pockets.

g. For critical areas, the repaired surface should not exceed 3 percent of the unit surface area.

h. Defects shall be repaired by sanding or grinding to remove defective areas, followed by recoating with an overlay of resin and reinforcement consisting of a minimum of one layer of 1.5 oz. chopped strand glass mat plus a glass surfacing mat. All repaired areas shall be built up until the surface is at least flush and the original thickness is regained. Pits or other small, deep defects first shall be filled with resin putty before making the overlay.

2. Inspection by the Engineer, or his failure to provide inspection, shall not relieve the Fabricator of his responsibility to provide materials, perform the work and deliver finished products in accordance with the specifications. Advance notice of 24 hours must be given prior to the time an item that will be available for inspection.

3. The Engineer shall have the right to sample and test any of the specimens even after the delivery, and to reject any item represented by the specimen which fails to comply with the specified requirements.

2.02 EXPANSION JOINTS

A. Provide expansion joints where shown on the Drawings and as required to avoid damage to the duct or equipment. For straight duct runs, locate expansion joints every 75 feet or less. There must be a minimum of 1 expansion joint in each straight duct run.

B. Type: W-design configuration with integral flanges suitable for service with FRP duct under the conditions specified.

C. Material: EPDM.

D. Backing Rings: 3/8 inch thick, 2 inches wide, Type 316 stainless steel.

E. Extension: 3 inches.

F. Compression: 2.5 inches.

G. Lateral Offset: 2.5 inches.

H. Thickness: ¼ inch, minimum.

I. Bolts, Nuts and Washers: Type 316 stainless steel.

J. Expansion joints shall be manufactured by RM-Holz, The Metraflex Company, Garlock, or equal.

2.03 FRP BUTTERFLY DAMPERS:

A. Round Fiberglass Reinforced Plastic Dampers:

1. All round FRP dampers shall be the butterfly type. FRP fabrication shall meet the corrosion requirements specified in this Section for FRP ductwork.

a. Dampers shall be Control-type dampers.

2. Leakage:

a. Control Dampers: Leakage shall not exceed 1% of total airflow at 30 inches w.g.

3. Fabrication:

a. Frame and Blade: Premium vinyl ester resin with minimum 100 mils corrosion barrier.

b. Shaft: Premium vinyl ester for all manually actuated dampers below 20 inches in diameter and Type 316 stainless steel for all dampers 20 inches in diameter and larger.

c. Bearings and Bushings: Teflon.

d. Pins and all Hardware: Type 316 stainless steel.

e. Shaft seals: EPDM.

f. Provide all round dampers with a blade stop consisting of FRP angles with full circumference EPDM seals, mechanically fastened to blade (seal not required for control dampers).

g. All dampers shall have flanged ends. Flanges per ductwork specification. Provide Type 316 stainless steel bolts, nuts and washers.

h. FRP dampers shall be manufactured by Swartwout, Division of Phillips Industries, Belco Manufacturing or equal as follows:

1) Control: Belco Model 201, Swartout Model 912 or equal.

4. Provide manual operators unless otherwise shown on the Drawings:

a. Sizes smaller than 20-Inches:

1) Hand-quadrant actuators, maximum 5-degree increments (or continuous).
2) Type 316 SST.
3) Provide locking bolt.

b. Dampers 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.

2.04 DUCT HANGERS AND SUPPORTS

A. All duct supports, interior and exterior, shall meet the requirements of Section 15020 – Pipe Supports, except that hangers and supports for FRP duct spacing shall be as specified in Paragraph 2.01 A.2 of this Section. Duct spans shall not exceed the duct manufacturer's recommendations.

B. Duct supports located on the exterior of the building shall be designed to include the weight of the duct and to withstand all applicable combinations of wind loading in accordance with the Florida Building Code, latest edition, as well as any additional local regulations which are in effect at the time of construction. Exterior supports shall be located as required by the piping system design and shall be per the standard details shown on the Drawings. Where duct support locations are shown on the Drawings, these locations should be considered to be approximate, and the CONTRACTOR (via the Professional Engineer) shall be required to confirm the support requirements and locations.

C. The CONTRACTOR shall note that not all duct support locations are shown on the Drawings, and the CONTRACTOR shall follow the Specifications herein in locating additional supports as required. The CONTRACTOR shall be responsible for the design of additional supports and for the overall stability of the entire support system. Support and hanger details and a detailed layout showing the location of all duct supports and hangers

shall be submitted in the Shop Drawings and stamped by a registered Professional Engineer in the State of Florida (Structural).

D. There shall not be less than ¼ inch buildup of FRP over the duct at each saddle support.

E. Unless otherwise shown on the Drawings, duct supports are to be fabricated from Type 316 Stainless Steel. All fasteners and anchors are to be Type 316 Stainless Steel.

F. Provide duct supports on both sides of each expansion joint.

PART 3 – EXECUTION

3.01 INSTALLATION

A. General: All FRP duct shall be installed in a neat and workmanlike manner, properly aligned, and cut from measurements taken at the site to avoid interferences with structural members, architectural features, openings, and equipment. Exposed pipes shall afford maximum headroom and access to equipment, and where necessary. All installations shall be acceptable to the Engineer. It is recommended that the CONTRACTOR obtain the assistance of the duct manufacturer's field representative to instruct the duct fitters in the correct installation and support of all FRP duct. The CONTRACTOR shall obtain training by the duct manufacturer's field representative in the correct installation and support of all FRP duct. Instruction shall be a minimum of one eight (8) hour day.

B. Sloping: All duct shall be installed with sufficient slopes (minimum 1/16" per foot) for venting and drainage of liquids and condensate to low points. Provide 1" port with PVC p-trap and PVC ball valve at each low point for condensate removal.

C. Supports and Anchors: All piping shall be firmly supported with fabricated or commercial hangers or supports in accordance with the requirements in Section 15020 – Pipe Supports. Where necessary to avoid stress on equipment or structural members, the pipes shall be anchored or harnessed. Expansion joints and guides shall compensate for pipe expansion due to temperature differences. Provide a minimum an expansion joint at the connections to each structure and entrance/exit to each structure, vessel, piece of equipment, and fan.

3.02 DUCT PREPARATION

A. Prior to installation, each duct length shall be carefully inspected, flushed clean of any debris or dust, and straightened, if not true. All pipe fittings shall be equally cleaned before assembly.

3.03 DUCT JOINTS

A. Adhesive Joints: Adhesive joints shall be made with freshly mixed 2-part epoxy on clean dry duct ends. The joints shall be made up at the recommended ambient temperatures, to the duct manufacturer's written recommendations. All duct ends shall be inserted to the full depth of the socket.

B. Flanged Joints: Flanged joints shall be made up in accordance with Section 15000, Basic Mechanical Requirements.

3.04 INSPECTION AND FIELD TESTING

A. Inspection: All finished installations shall be carefully inspected for proper joints and sufficient supports, anchoring, interference, and damage to duct, fittings, and coating. Damage and leaks shall be repaired to the satisfaction of the Engineer.

B. All ductwork shall be leak tested in accordance with SMACNA Air Duct Leakage Test Manual, or appropriate international standard. Duct system shall be sealed to provide a system that is within an allowable leakage limit of 2.5 percent of total air flow at system operating flow and pressure. The ductwork test report shall be submitted to the Engineer.

C. If the system is testing in sections, the leakage rates shall be added to define the performance of the whole system.

D. Provide check out and certification of the installation, supervision of initial operation, and training related to the FRP butterfly dampers.

E. Ductwork system shall be tested, adjusted and balanced (TAB) in accordance with the requirements of Section 15990, Testing, Adjusting, and Balancing to provide the required airflow rate from each individual take-off point within a tolerance of +/- 5%. Submit testing, adjusting, and balancing reports bearing the seal and signature of the Test and Balance Engineer. Mark equipment settings, including damper control positions, valve indicators, fan speed control levers, and similar controls and devices, to show final settings. Mark with paint or other suitable, permanent identification materials.

- END OF SECTION -

SECTION 15990 – TESTING, ADJUSTING, AND BALANCING

PART 1 - GENERAL

1.01 THE REQUIREMENT

A. This Section specifies the requirements and procedures for testing, adjusting, and balancing the odor control system. Requirements include measurement and establishment of the fluid quantities of the HVAC systems as required to meet design specifications, and recording and reporting the results.

B. This Section does not include specifications for materials for patching HVAC systems, or specifications for materials and installation of adjusting and balancing devices. If devices must be added to achieve proper adjusting and balancing, refer to the respective system sections for materials and installation requirements. In addition, this Section does not include requirements and procedures for piping and ductwork systems leakage tests.

1.02 DEFINITIONS

A. Systems testing, adjusting, and balancing is the process of checking and adjusting all the building environmental systems to produce the design objectives. It includes the balance of air and water distribution, the adjustment of total system to provide design quantities, the electrical measurement, and the verification of performance of all equipment and automatic controls.

1. Test: To determine quantitative performance of equipment.

2. Adjust: To regulate the specified fluid flow rate and air patterns at the terminal equipment (e.g., reduce fan speed, throttling).

3. Balance: To proportion flows within the distribution system (submains, branches, and terminals) according to specified design quantities.

4. Procedure: Standardized approach and execution of sequence of work operations to yield reproducible results.

5. Report Forms: Test data sheets arranged for collecting test data in logical order for submission and review. These data should also form the permanent record to be used as the basis for required future testing, adjusting, and balancing.

6. Terminal: The point where the controlled fluid enters or leaves the distribution system. These are supply inlets on water terminals, supply outlets on air terminals, return outlets on water terminals, and exhaust or return inlets on air terminals such as registers, grilles, diffusers, louvers, and hoods.

7. Main: Duct or pipe containing the system's major or entire fluid flow.

8. Submain: Duct or pipe containing part of the systems' capacity and serving two or more branch mains.

9. Branch Main: Duct or pipe serving two or more terminals.

10. Branch: Duct or pipe serving a single terminal.

1.03 SUBMITTALS

A. Submit proof that the Test and Balance Engineer assigned to supervise the procedures, and the technicians proposed to perform the procedures meet the qualifications specified below.

B. Submit testing, adjusting, and balancing reports bearing the seal and signature of the Test and Balance Engineer. The reports shall be certified proof that the systems have been tested, adjusted, and balanced in accordance with the referenced standards; are an accurate representation of how the systems have been installed; are a true representation of how the systems are operating at the completion of the testing, adjusting, and balancing procedures; and are an accurate record of all final quantities measured, to establish normal operating values of the systems. Follow the procedures and format specified below:

1. Final Report: Upon completion of testing, adjusting, and balancing procedures, prepare final reports, type written, and organized and formatted as specified below. Submit two (2) complete sets of final reports.

2. Report Format: Report forms shall be those standard forms prepared by the referenced standard for each respective item and system to be tested, adjusted, and balanced. Bind report forms complete with schematic systems diagrams and other data in reinforced, vinyl, three-ring binders. Provide binding edge labels with the project identification and a title descriptive of the contents. Divide the contents of the binder into the below listed divisions, separated by divider tabs:

   General Information and Summary
   Air Systems
   Temperature Control Systems

3. Report Contents: Provide the following minimum information, forms and data:

   General Information and Summary: Inside cover sheet to identify testing, adjusting, and balancing agency, Contractor, Owner, Architect, Engineer, and Project. Include addresses, and contact names and telephone numbers. Also include a certification sheet containing the seal and name, address, telephone number, and signature of the Certified Test and Balance Engineer. Include in this division a listing of the instrumentations used for the procedures along with the proof of calibration.

   The remainder of the report shall contain the appropriate forms containing as a minimum, the information indicated on the standard report forms prepared by the AABC and NEBB, for each respective item and system. Prepare a schematic diagram for each item of equipment and system to accompany each respective report form.

4. Calibration Reports: Submit proof that all required instrumentation has been calibrated to tolerances specified in the referenced standards, within a period of six months prior to starting the project.

1.04 QUALITY ASSURANCE

A. Test and Balance Personnel Qualifications: The personnel responsible for testing, adjusting, and balancing the specified systems shall have at least three years experience in testing and balancing systems similar to this project and shall be an employee of the installer or an independent testing and balancing agency.

B. Codes and Standards:

1. NEBB, "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems."

2. ASHRAE Handbook, 1984 Systems Volume, Chapter 37, Testing, Adjusting, and Balancing.

1.05 SEQUENCING AND SCHEDULING

A. Systems shall be fully operational prior to beginning procedures.

B. Test, adjust and balance air conditioning systems during summer season and heating systems during winter season, including at least a period of operation at outside conditions within 5 deg F wet bulb temperature of maximum summer design condition, and within 10 deg F dry bulb temperature of minimum winter design condition. Take final temperature readings during seasonal operation.

1.06 RELATED WORK SPECIFIED ELSEWHERE

A. Section 13352 – FRP Ductwork

PART 2 -- MATERIALS
(NOT USED)

PART 3 -- EXECUTION

3.01 PRELIMINARY PROCEDURES FOR AIR SYSTEM BALANCING

A. Before operating the system, perform the following steps:

1. Walk the system from the system air handling equipment to terminal units to determine variations of installation from design.

2. Check filters for cleanliness.

3. Check dampers (both volume and fire) for correct and locked position, and temperature control for completeness of installation before starting fans.

4. Prepare report test sheets for both fans and outlets. Obtain manufacturer's outlet factors and recommended procedures for testing. Prepare a summation of required outlet volumes to permit a crosscheck with required fan volumes.

5. Determine best locations in main and branch ductwork for most accurate duct traverses.

6. Place outlet dampers in the full open position.

7. Prepare "record drawings/as-builts" of system ductwork and piping layouts to facilitate reporting.

8. Lubricate all motors and bearings.

9. Check fan belt tension.

10. Check fan rotation.

3.02 MEASUREMENTS

A. Provide all required instrumentation to obtain proper measurements, calibrated to the tolerances specified in the referenced standards. Instruments shall be properly maintained and protected against damage.

B. Provide instruments meeting the specifications of the referenced standards.

C. Use only those instruments which have the maximum field measuring accuracy and are best suited to the function being measured.

D. Apply instrument as recommended by the manufacturer.

E. Use instruments with minimum scale and maximum subdivisions and with scale ranges proper for the value being measured.

F. When averaging values, take a sufficient quantity of readings which will result in a repeatability error of less than 5 percent. When measuring a single point, repeat readings until 2 consecutive identical values are obtained.

G. Take all readings with the eye at the level of the indicated value to prevent parallax.

H. Use pulsation dampeners where necessary to eliminate error involved in estimating average of rapidly fluctuation readings.

I. Take measurements in the system where best suited to the task.

3.03 PERFORMING TESTING, ADJUSTING, AND BALANCING

A. Perform testing and balancing procedures on each system identified in accordance with the detailed procedures outlined in the referenced standards.

B. Cut insulation, ductwork, and piping for installation of test probes to the minimum extent necessary to allow adequate performance of procedures.

C. Patch insulation, ductwork, and housings using materials identical to those removed.

D. Seal ducts and piping, and test for and repair leaks.

E. Seal insulation to re-establish integrity of the vapor barrier.

F. Mark equipment settings, including damper control positions, valve indicators, fan speed control levers, and similar controls and devices, to show final settings. Mark with paint or other suitable, permanent identification materials.

G. Retest, adjust, and balance systems subsequent to significant system modifications, and resubmit test results.

3.04 RECORD AND REPORT DATA

A. Record all data obtained during testing, adjusting, and balancing in accordance with, and on the forms recommended by the referenced standards.

B. Prepare report of recommendations for correcting unsatisfactory mechanical performances when system cannot be successfully balanced.

3.05 TRAINING

A. Train the CITY's maintenance personnel on troubleshooting procedures and testing, adjusting, and balancing procedures.

B. Check out and certification of the installation, supervision of initial operation, and training related to the FRP butterfly dampers shall be performed in accordance with Section 15095 – Valves, General and other applicable Sections of these Specifications.

- 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 Section 01300, Submittals, and Section 01700, 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:

$$L = \frac{SD\sqrt{P}}{}$$

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. Refer to Section 17000, Control and Information System Scope and General Requirements for scope of work details as they relate to the Division 17.

C. The electrical scope of work for this project primarily includes, but is not limited to, the following:

1. Demolish existing control panels, instruments, wiring, conduits and mounting hardware associated with the existing OFDB odor control and air handling systems as indicated on the drawings.

2. Provide and install all electrical shown and or required for the new Odor Control System and Instrument Air Compressor System. Coordinate with equipment suppliers for all electrical requirements to provide and install all equipment, raceways, wiring, boxes, fittings, etc. for a complete operational electrical system.

3. Provide and install site lighting as specified in the Contract Documents.

4. Other electrical work as specified herein and indicated on the Drawings.

D. All material and equipment must be the product of an established, reputable, and approved 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., where such approval is available for the product of the listed manufacturer as approved by the ENGINEER.

E. When a specified or indicated item has been superseded or is no longer available, the manufacturer's latest equivalent type or model of material or equipment, subject to approval by the ENGINEER, shall be furnished and installed at no additional cost to the CITY.

F. Where the CONTRACTOR's selection of equipment of specified manufacturers or additionally approved manufacturers requires changes or additions to the system design, the CONTRACTOR shall be responsible in all respects for the modifications to all system designs, subject to approval of the ENGINEER. The CONTRACTOR's bid shall include all costs for all work of the Contract for all trades made necessary by such changes, additions or modifications or resulting from any approved substitution.

G. Furnish and install all stands, racks, brackets, supports, and similar equipment required to properly serve the equipment which is furnished under this Contract, or equipment otherwise specified or indicated on the Drawings.

1.02 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 ensure that proposed equipment will fit properly in spaces indicated.

B. Where outlets are shown near identified equipment furnished by this or other Contractors, it is the intent of the Specifications and Drawings that the outlet be located at the equipment to be served. The CONTRACTOR shall coordinate the location of these outlets to be near the final location of the equipment served whether placed correctly or incorrectly on the Drawings.

1.03 LOCAL CONDITIONS

A. The CONTRACTOR shall examine the site and become familiar with conditions affecting the work. The CONTRACTOR shall investigate, determine, and verify locations of any overhead or buried utilities on or near the site, and shall determine such locations in conjunction with all public and/or private utility companies and with all authorities having jurisdiction.

1.04 SUBMITTALS

A. In accordance with the procedures and requirements set forth in the Public Utilities 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. Each equipment submittal shall include an equipment vendor’s recommended Spare Parts List and shall include a Spare Parts List indicating provided spare parts.

4. Proposed Testing Methods and Reports of Certified Shop Tests.

5. Reports of Certified Field Tests.

6. 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 inadequate information.

1.05 APPLICABLE CODES AND REQUIREMENTS

A. Conformance

1. All work, equipment and materials furnished shall conform with the latest adopted existing rules, requirements and specifications of the following:

a. Insurance Rating Organization having jurisdiction

b. The serving electrical utility company

c. The currently adopted edition of the National Electrical Code (NEC, NFPA 70)

d. The currently adopted edition of the National Electrical Safety ((NFPA 70E) Code

e. The National Electric Manufacturers Association (NEMA)

f. The Institute of Electrical and Electronic Engineers (IEEE)

g. The Insulated Cable Engineers Association (ICEA)

h. The American Society of Testing Materials (ASTM)

i. The American National Standards Institute (ANSI)

j. The requirements of the Occupational Safety Hazards Act (OSHA)

k. The National Electrical Contractors Association (NECA) Standard of Installation

l. National Fire Protection Association (NFPA)

m. International Electrical Testing Association (NETA)

n. 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.

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 and shall deliver same to the ENGINEER and the CITY.

1.06 PERMITS AND INSPECTIONS

A. The CONTRACTOR shall reference the Public Utilities General Conditions and Section 01010, Summary of Work.

1.07 TEMPORARY LIGHTING AND POWER

A. The CONTRACTOR shall reference the Public Utilities General Conditions and Section 01510, Temporary Utilities.

1.08 TESTS

A. Upon completion of the installation, the CONTRACTOR shall perform tests for operation, load (Phase) balance, overloads, and short circuits. Tests shall be made with and to the satisfaction of the CITY and ENGINEER.

B. The CONTRACTOR shall perform all field tests and shall provide all labor, equipment, and incidentals required for testing and shall pay for electric power required for the tests. All defective material and workmanship disclosed shall be corrected by the CONTRACTOR at no cost to the 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. Refer to each individual specification section for detailed test requirements.

D. The CONTRACTOR shall complete the installation and field testing of the electrical installation at least two (2) weeks prior to the start up and testing of all other equipment. during the period between the completion of electrical installation and the start up and testing of all other equipment, the CONTRACTOR shall make all components of the Work available as it is completed for their use in performing Preliminary and Final Field Tests.

E. Before each test commences, the CONTRACTOR shall submit a detailed test procedure, and also provide test engineer resume, manpower and scheduling information for the approval by the ENGINEER. In addition, the CONTRACTOR shall furnish detailed test procedures for any equipment required as part of the field tests of other systems.

1.09 INFRARED INSPECTION

A. Just prior to the final acceptance of a piece of equipment, the CONTRACTOR shall perform an infrared inspection to locate and correct all heating problems associated with electrical equipment terminations. The infrared inspection shall be performed by a third party, independent testing agency, not the Electrical Contractor. All testing shall be done with the components fully loaded.

B. 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 equipment furnished and installed under the Scope of this Contract shall be corrected by the CONTRACTOR. All problems detected with portions of existing equipment modified under this Contract shall also be corrected by the CONTRACTOR.

C. Any issues detected with portions of existing equipment that were not modified under this Contract are not the responsibility of the CONTRACTOR. Despite the CONTRACTOR not being held responsible for these problems, the CONTRACTOR shall report them to the CITY and ENGINEER immediately for resolution.

D. The infrared inspection report shall include both digital and IR pictures positioned side by side. Both the digital and IR pictures shall be clear and high quality. Fuzzy, grainy, or poorly illuminated pictures are not acceptable. The IR picture shall be provided with a temperature scale beside it, and an indication of the hot spot temperature in each picture. Reports shall be furnished in a 3-ring binder, with all pages printed in full color, with equipment assemblies separated by tabs.

1.10 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.

1.11 SCHEDULES AND FACILITY OPERATIONS

A. All testing procedures and schedules must be submitted to the ENGINEER for review and approval two (2) weeks prior to any work beginning. When testing has been scheduled, the ENGINEER must be notified 48 hours prior to any work.

B. In the event of accidental shutdown of CITY equipment, the CONTRACTOR shall notify CITY personnel immediately to allow for an orderly restart of affected equipment.

C. Maintaining the operation of the 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. Refer to Section 01520, Maintenance of Facilities and Sequence of Construction, for construction sequencing and specific operational constraint information.

1.12 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 will be rejected. Electrical conduit shall be stored to provide protection from the weather and accidental damage. Rigid non-metallic conduit shall be stored on even supports and in locations not subject to direct sun rays or excessive heat. Cables shall be sealed, stored, and handled carefully to avoid damage to the outer covering or insulation and damage from moisture and weather. Adequate protection shall be required at all times for electrical equipment and accessories until installed and accepted. Materials damaged during shipment, storage, installation, or testing shall be replaced or repaired in a manner meeting with the approval of the ENGINEER. If space heaters are provided in a piece of electrical equipment, they shall be connected to a power source during storage. The CONTRACTOR shall store equipment and materials in accordance with Section 01550 - Site Access and Storage.

1.13 WARRANTIES

A. Unless otherwise specified in an individual specification section, all equipment and electrical construction materials furnished and installed under Division 16 shall be provided with a warranty in accordance with the requirements of Section 11000 - Equipment General Provisions, and the Public Utilities General Conditions.

1.14 TRAINING

A. Unless otherwise specified in an individual specification section, all training for equipment furnished and installed under Division 16 shall be provided in accordance with the requirements of Section 11000, Equipment General Provisions.

PART 2 – PRODUCTS

2.01 PRODUCT REQUIREMENTS

A. Unless otherwise indicated, the materials to be provided under this Specification shall be the products of manufacturers regularly engaged in the production of all such items and shall be the manufacturer's latest design. The products shall conform to the applicable standards of UL and NEMA, unless specified otherwise. International Electrotechnical Commission (IEC) standards are not recognized for MCC parts, disconnect switches, and panelboards.

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 to this requirement.

2.02 SUBSTITUTIONS

A. Unless specifically noted otherwise, any reference in the Specifications or on the Drawings to any article, service, product, material, fixture, or item of equipment by name, make, or catalog number shall be interpreted as establishing the type, function, and standard of quality and shall not be construed as limiting competition. The CONTRACTOR, in such cases may, at his option use any article, device, product, material, fixture, or item of equipment which in the judgment of the ENGINEER, expressed in writing, is equal to or better than specified.

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 is unsatisfactory, then the CONTRACTOR shall replace damaged equipment at his own expense.

3.02 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 16111 – CONDUIT

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The CONTRACTOR shall furnish and install conduits and conduit fittings to complete the installation of all electrically operated equipment as specified herein, indicated on the Drawings, and as required.

B. Requirements for conduit clamps, support systems, and anchoring are not included in this Section. Refer to Section 16190, Supporting Devices, for these requirements.

C. Reference Section 16000 - Basic Electrical Requirements and Section 16195 - Electrical Identification.

1.02 CODES AND STANDARDS

A. Conduits and conduit fittings shall be designed, manufactured, and/or listed to the following standards as applicable:

1. American National Standards Institute (ANSI)

    a. ANSI B1.20.1 – Pipe Threads, General Purpose
    b. ANSI C80.1 – Electrical Rigid Steel Conduit
    c. ANSI C80.3 – Steel Electrical Metallic Tubing
    d. ANSI C80.5 – Electrical Rigid Aluminum Conduit
    e. ANSI FB 1 – Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable

2. Underwriters Laboratories (UL)

    a. UL 1 – Standard for Flexible Metal Conduit
    b. UL 6 - Electrical Rigid Metal Conduit-Steel
    c. UL 6A – Electrical Rigid Metal Conduit-Aluminum, Red Brass, and Stainless Steel
    d. UL 360 – Standard for Liquid-tight Flexible Metal Conduit
    e. UL 467 – Grounding and Bonding Equipment
    f. UL 514B – Conduit, Tubing, and Cable Fittings
    g. UL 651 – Standard for Schedule 40 and 80 Conduit and Fittings
    h. UL 797 – Electrical Metallic Tubing-Steel
    i. UL 1203 - Standard for Explosion-proof and Dust-ignition-proof Electrical Equipment for use in Hazardous (Classified) Locations
    j. UL 1479 – Standard for Fire Tests of Penetration Fire Stops
    k. UL 1660 – Liquid-tight Flexible Nonmetallic Conduit

3. National Electrical Manufacturer's Association (NEMA)

   a. NEMA RN 1 – PVC Externally Coated Galvanized Rigid Steel Conduit
   b. NEMA TC-2 – Electrical PVC Conduit
   c. NEMA TC-3 – PVC Fittings for Use with Rigid PVC Conduit and Tubing

4. Others

   a. ACI-318 – Building Code Requirements for Structural Concrete

1.03 SUBMITTALS

A. In accordance with the procedures and requirements set forth in the Public Utilities General Conditions and Section 01300 – Submittals, the CONTRACTOR shall obtain from the equipment manufacturer and submit the following:

   1. Shop Drawings

B. Each submittal shall be identified by the applicable specification section.

1.04 SHOP DRAWINGS

A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.

B. Partial, incomplete, or illegible submittals will be returned to the CONTRACTOR without review for resubmittal.

C. Shop drawings shall include but not be limited to:

   1. Product data sheets for conduits and fittings.

   2. Conduit identification methods and materials.

   3. Evidence of training for all personnel that will install PVC coated rigid metal conduit.

1.05 DEFINITIONS

A. Conduits are categorized by the circuit type of the wiring to be installed inside. Conduits are defined as follows:

   1. Power Conduits – Conduits that carry AC or DC power wiring from a source to a load. Conduits that carry lighting and receptacle wiring.

2. Control Conduits – Conduits that carry AC or DC discrete control wiring between devices and/or equipment. Conduits that carry fiber optic cables between devices and/or equipment.

3. Instrumentation Conduits – Conduits that carry AC or DC analog signal wiring between devices and/or equipment.

B. Where conduit tags are used on the drawings, conduit categories are indicated on the Drawings by the leading letter of the conduit tag. Conduit tag leading letters are defined as follows:

1. P – Power Conduit

2. C – Control Conduit

3. I – Instrumentation Conduit

PART 2 – PRODUCTS

2.01 GENERAL

A. Conduit and conduit fitting products are specified in the text that follows this article. Reference Part 3 herein for the application, uses and installation requirements of these conduits and conduit fittings.

B. All metallic conduit fittings shall be UL 514B and UL 467 Listed, and constructed in accordance with ANSI FB 1. All metallic conduit fittings for use in Class I Division I hazardous areas shall be UL 1203 Listed. All non-metallic fittings shall be UL 651 Listed and constructed in accordance with NEMA TC-3.

C. Flexible conduit couplings for use in Class I Division I hazardous areas shall have threaded stainless steel end fittings and a flexible braided core. Flexible braid shall be constructed of stainless steel where available in the conduit trade size required for the application. Where stainless steel braid is not available, the braid shall be provided with a PVC coating. No other braid types or materials are acceptable.

D. Where threading is specified herein for conduit fitting connections, the fittings shall be manufactured to accept conduit that is threaded to ANSI B1.20.1 requirements.

E. Conduit expansion fittings for all conduit materials of construction shall be capable of 4 inches of movement along the axis of the conduit for trade sizes 2 inches or less. Expansion fittings shall be capable of 8 inches of movement along the axis of the conduit for trade sizes greater than 2 inches.

F. Conduit deflection fittings for all conduit materials of construction shall be provided with a flexible neoprene outer jacket that permits up to ¾ inch of expansion/contraction along the

axis of the conduit as well as up to ¾ inch of parallel misalignment between the conduit axes. Outer jacket shall be secured to the conduit hubs by stainless steel clamps.

G. Conduit seals shall either be Listed and labeled for 40% fill, or conduit reducing fittings and a trade size larger conduit seal shall be provided to achieve 25% or less fill within the seal. Percentage fill calculation shall be based on the conductors to be installed. Conduit seals shall be provided with breathers and/or drains where required by the NEC.

H. Conduit insulating bushings shall be constructed of plastic and shall have internal threading.

I. Additional conduit and conduit fitting requirements are specified in the articles that follow, based on the specific conduit material of construction to be used.

2.02 RIGID GALVANIZED STEEL (RGS) CONDUIT AND ASSOCIATED FITTINGS

A. Conduit

1. Conduit shall be hot dip galvanized on the inside and outside, and made of heavy wall high strength ductile steel. Conduit shall be manufactured in accordance with ANSI C80.1, and shall be UL 6 Listed.

2. Conduit shall be provided with factory-cut ¾" per foot tapered threads at each end in accordance with ANSI B1.20.1. Threads shall be cut prior to galvanizing to ensure corrosion protection adequately protects the threads. Conduit shall be provided with a matching coupling on one end and a color-coded thread protector on the other.

B. Conduit Bodies for use with Rigid Galvanized Steel

1. Conduit bodies shall be constructed of an electro-galvanized malleable iron alloy which is coated with an acrylic paint finish. Conduit bodies shall have integral threaded conduit hubs.

2. Conduit bodies for Class I Division I hazardous areas shall be provided with integrally threaded covers constructed of an electro-galvanized malleable iron alloy which is coated with an acrylic paint finish.

3. Conduit bodies for all other areas shall be provided with covers that are affixed in place by stainless steel screws which thread directly into the conduit body. Covers that utilize wedge nuts or any other method of attachment to the conduit body are not acceptable. Covers shall be constructed of an electro-galvanized malleable iron alloy which is coated with an acrylic paint finish. Covers shall be provided with matching gasket.

C. Conduit Couplings, Nipples, and Unions for use with Rigid Galvanized Steel

1. Couplings and nipples shall be threaded and shall be constructed of hot dipped galvanized steel. Split-type couplings that use compression to connect conduits are not acceptable.

2. Unions shall be threaded, rain-tight, and constructed of an electro-galvanized malleable iron alloy which is coated with an acrylic paint finish.

D. Conduit Expansion and Deflection Fittings for use with Rigid Galvanized Steel

1. Conduit expansion fittings and conduit deflection fittings shall be constructed of an electro-galvanized malleable iron alloy which is coated with an acrylic paint finish. Expansion and deflection fittings shall have threaded conduit connections.

2. Expansion fittings shall have an integral bonding jumper and deflection fittings shall have an external bonding jumper.

E. Conduit Seals for use with Rigid Galvanized Steel

1. Conduit seals shall be constructed of an electro-galvanized malleable iron alloy which is coated with an acrylic paint finish. Conduit seals shall have threaded conduit connections.

F. Conduit Termination Fittings for use with Rigid Galvanized Steel

1. Conduit hubs shall be constructed of stainless steel and shall have threaded connections to the conduit and enclosure. Hubs shall have a plastic insulated throat and shall be watertight when assembled to an enclosure.

2. Conduit locknuts shall be constructed of zinc plated steel. Locknuts shall have internal threading. Locknuts with integral gasket or seal are not acceptable. Locknuts shall have integral bonding screw where required for proper bonding.

3. Conduit bonding bushings shall be constructed of zinc plated malleable iron. Bonding bushings shall have a threaded conduit connection. Bonding bushing shall be provided with properly sized set screw for connecting bonding conductor and an integral plastic insulator rated for 150 degrees C located in the throat.

2.03 RIGID NONMETALLIC CONDUIT AND ASSOCIATED FITTINGS

A. Conduit

1. Conduit shall be Schedule 40 or 80 (dependent on application) polyvinyl chloride (PVC) construction, manufactured in accordance with NEMA TC-2, UL 651 Listed, and suitable for conductors with 90 degree C insulation.

B. Conduit Bodies for use with Rigid Nonmetallic Conduit

1. Conduit bodies shall be constructed of PVC. Conduit hubs shall be integral to the conduit body and shall be smooth inside to accept a glued conduit connection.

2. Conduit body shall be provided with cover that is affixed in place by stainless steel screws which thread directly into the conduit body. Covers that utilize wedge nuts or any other method of attachment to the conduit body are not acceptable. Covers shall be provided with matching gasket.

C. Conduit Couplings and Unions for use with Rigid Nonmetallic Conduit

1. Conduit couplings and unions shall be constructed of PVC and shall be smooth inside to accept a glued conduit connection.

D. Conduit Expansion and Deflection Fittings for use with Rigid Nonmetallic Conduit

1. Conduit expansion fittings and conduit deflection fittings shall be constructed of PVC and shall be smooth inside to accept a glued conduit connection.

E. Conduit Termination Fittings for use with Rigid Nonmetallic Conduit

1. Conduit hubs shall be constructed of PVC and shall be smooth inside to accept a glued conduit connection. Hubs shall have external threads and an accompanying PVC locknut, and shall be watertight when assembled to an enclosure.

2. Conduit locknuts shall be constructed of zinc plated steel. Locknuts shall have internal threading. Locknuts constructed of PVC and locknuts with integral gasket or seal are not acceptable.

3. Conduit end bells shall be constructed of PVC and shall be smooth inside to accept a glued conduit connection. End bell shall have a smooth inner surface that curves outward towards the edge of the fitting.

2.04 PVC COATED RIGID GALVANIZED STEEL CONDUIT AND ASSOCIATED FITTINGS

A. General

1. Where an external coating of polyvinyl chloride (PVC) is specified for conduit and fittings, the coating shall be 40 mil (minimum) thickness. Where an internal coating of urethane is specified for conduit and fittings, the coating shall be 2 mil (minimum) thickness.

2. All conduit fittings shall have a sealing sleeve constructed of PVC which covers all connections to conduit. Sleeves shall be appropriately sized so that no conduit threads will be exposed after assembly.

B. Conduit

1. Conduit shall be hot dip galvanized on the inside and outside, and made of heavy wall high strength ductile steel. Conduit shall be manufactured in accordance with ANSI C80.1, and shall be UL 6 Listed.

2. Conduit shall be provided with factory-cut ¾" per foot tapered threads at each end in accordance with ANSI B1.20.1. Threads shall be cut prior to galvanizing to ensure corrosion protection adequately protects the threads. Conduit shall be provided with a matching coupling on one end and a color-coded thread protector on the other.

3. Conduit shall be coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane. Conduit shall be manufactured in accordance with NEMA RN-1.

C. Conduit Bodies for use with PVC Coated Rigid Galvanized Steel Conduit

1. Conduit bodies shall be constructed of an electro-galvanized malleable iron alloy which is coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane. Conduit bodies shall have integral threaded conduit hubs.

2. Conduit bodies for Class I Division I hazardous areas shall be provided with integrally threaded covers constructed of an electro-galvanized malleable iron alloy which is coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane.

3. Conduit bodies for all other areas shall be constructed of an electro-galvanized malleable iron alloy which is coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane. Covers shall be affixed in place by stainless steel screws which thread directly into the conduit body and have a plastic encapsulated head. Covers that utilize wedge nuts or any other method of attachment to the conduit body are not acceptable. Covers shall be provided with matching gasket.

D. Conduit Couplings, Nipples, and Unions for use with PVC Coated Rigid Galvanized Steel Conduit

1. Couplings and nipples shall be threaded and shall be constructed of hot dipped galvanized steel which is coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane. Split-type couplings that use compression to connect conduits are not acceptable.

2. Unions shall be threaded, rain-tight, and constructed of an electro-galvanized malleable iron alloy which is coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane.

E. Conduit Expansion and Deflection Fittings for use with PVC Coated Rigid Galvanized Steel Conduit

1. Conduit expansion fittings and conduit deflection fittings shall be constructed of an electro-galvanized malleable iron alloy which is coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane. Expansion and deflection fittings shall have threaded conduit connections.

2. Expansion fittings shall have an integral bonding jumper and deflection fittings shall have an external bonding jumper.

F. Conduit Seals for use with PVC Coated Rigid Galvanized Steel Conduit

1. Conduit seals shall be constructed of an electro-galvanized malleable iron alloy which is coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane. Conduit seals shall have threaded conduit connections.

G. Conduit Termination Fittings for use with PVC Coated Rigid Galvanized Steel Conduit

1. Conduit hubs shall be constructed of an electro-galvanized malleable iron alloy which is coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane. Hubs shall have threaded connections to the conduit and enclosure. Hubs shall have a plastic insulated throat and shall be watertight when assembled to an enclosure.

2. Conduit bonding bushings shall be constructed of zinc plated malleable iron which is coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane. Bonding bushings shall have a threaded conduit connection. Bonding bushing shall be provided with properly sized set screw for connecting bonding conductor and an integral plastic insulator rated for 150 degrees C located in the throat.

2.05 RIGID ALUMINUM CONDUIT AND ASSOCIATED FITTINGS

A. Conduit

1. Conduit shall be made of heavy wall high strength 6063 alloy aluminum with temper designation T1. Conduit shall be manufactured in accordance with ANSI C80.5, and shall be UL 6A Listed.

2. Conduit shall be provided with factory-cut ¾" per foot tapered threads at each end in accordance with ANSI B1.20.1. Threads shall be cut prior to galvanizing to ensure corrosion protection adequately protects the threads. Conduit shall be provided with a matching coupling on one end and a color-coded thread protector on the other.

B. Conduit Bodies for use with Rigid Aluminum Conduit

1. Conduit bodies shall be constructed of copper-free aluminum which is coated with an aluminum enamel finish. Conduit bodies shall have integral threaded conduit hubs.

2. Conduit bodies for Class I Division I hazardous areas shall be provided with integrally threaded covers constructed of copper-free aluminum which is coated with an aluminum enamel finish.

3. Conduit bodies for all other areas shall be provided with stamped copper-free aluminum covers that are affixed in place by stainless steel screws which thread directly into the conduit body. Covers that utilize wedge nuts or any other method of attachment to the conduit body are not acceptable. Covers shall be provided with matching gasket.

C. Conduit Couplings, Nipples, and Unions for use with Rigid Aluminum Conduit

1. Couplings and nipples shall be threaded and shall be constructed of heavy wall high strength 6063 alloy aluminum with temper designation T1. Split-type couplings that use compression to connect conduits are not acceptable.

2. Unions shall be threaded, rain-tight, and constructed of copper-free aluminum which is coated with an aluminum enamel finish.

D. Conduit Expansion and Deflection Fittings for use with Rigid Aluminum Conduit

1. Conduit expansion fittings and conduit deflection fittings shall be constructed of copper-free aluminum which is coated with an aluminum enamel finish. Expansion and deflection fittings shall have threaded conduit connections.

2. Expansion fittings shall have an integral bonding jumper and deflection fittings shall have an external bonding jumper.

E. Conduit Seals for use with Rigid Aluminum Conduit

1. Conduit seals shall be constructed of copper-free aluminum which is coated with an aluminum enamel finish. Conduit seals shall have threaded conduit connections.

F. Conduit Termination Fittings for use with Rigid Aluminum Conduit

1. Conduit hubs shall be constructed of copper-free aluminum and shall have threaded connections to the conduit and enclosure. Hubs shall have a plastic insulated throat and shall be watertight when assembled to an enclosure.

2. Conduit locknuts shall be constructed of copper-free aluminum. Locknuts shall have internal threading. Locknuts with integral gasket or seal are not acceptable. Locknuts shall have integral bonding screw where required for proper bonding.

3. Conduit bonding bushings shall be constructed of copper-free aluminum. Bonding bushings shall have a threaded conduit connection. Bonding bushing shall be provided with properly sized set screw for connecting bonding conductor and an integral plastic insulator rated for 150 degrees C located in the throat.

2.06 LIQUID TIGHT FLEXIBLE METAL CONDUIT (LFMC) AND ASSOCIATED FITTINGS

A. Conduit

1. Conduit shall be manufactured using a single strip of hot dip galvanized high strength steel alloy, helically formed into a continuously interlocked flexible metal conduit. Trade size 1-1/4" and smaller conduits shall be provided with an integrally woven copper bonding strip.

2. Conduit shall be covered with an outside PVC jacket that is UV resistant, moisture-proof, and oil-proof. Conduit shall be UL 360 Listed.

B. Conduit Termination Fittings for use with LFMC

1. Conduit termination fittings shall be constructed of either 304 stainless steel or an electro-galvanized malleable iron alloy which is coated on the exterior with a 40 mil (minimum) PVC jacket and coated on the interior with a 2 mil (minimum) layer of urethane. PVC coated fittings shall have a sealing sleeve constructed of PVC which covers the connection to conduit.

2. Termination fittings shall have a threaded end with matching locknut and sealing ring for termination to equipment, and shall have an integral external bonding lug where required for proper bonding. Termination fittings shall have a plastic insulated throat and shall be watertight when assembled to the conduit and equipment.

2.07 LIQUID TIGHT FLEXIBLE NONMETALLIC CONDUIT (LFNC) AND ASSOCIATED FITTINGS

A. Conduit

1. Conduit shall be constructed of rigid polyvinyl chloride (PVC), fabricated to provide flexibility. Conduit shall be covered with an outside PVC jacket that is UV resistant, moisture-proof, and oil-proof. Conduit shall be UL 1660 Listed.

B. Conduit Termination Fittings for use with LFNC

1. Conduit termination fittings shall be constructed PVC and shall have a threaded end with matching locknut and sealing ring for termination to equipment. Termination fittings shall be watertight when assembled to the conduit and equipment.

2.08 FLEXIBLE METAL CONDUIT (FMC) AND ASSOCIATED FITTINGS

A. Conduit

1. Conduit shall be manufactured using a single strip of hot dip galvanized high strength steel alloy, helically formed into a continuously interlocked flexible metal conduit. Conduit shall be UL 1 Listed.

B. Conduit Termination Fittings for use with FMC

1. Conduit termination fittings shall be constructed of an electro-galvanized malleable iron alloy. Fittings shall have a threaded end with matching locknut for termination to equipment, and a compression-style connection to the associated conduit.

2.09 ELECTRICAL METALLIC TUBING (EMT) AND ASSOCIATED FITTINGS

A. Conduit

1. Conduit shall be hot dipped galvanized on the inside and outside, and made of cold-rolled steel tubing. Conduit shall be manufactured in accordance with C80.3 and shall be UL 797 listed.

B. Conduit Bodies for use with EMT

1. Conduit bodies shall be constructed of an electro-galvanized malleable iron alloy which is coated with an acrylic paint finish. Conduit bodies shall have integral threaded conduit hubs.

2. Conduit bodies shall be provided with galvanized sheet steel covers that are affixed in place by stainless steel screws which thread directly into the conduit body. Covers that utilize wedge nuts or any other method of attachment to the conduit body are not acceptable. Covers shall be provided with matching gasket.

C. Conduit Couplings and Nipples for use with EMT

1. Couplings and nipples shall have threaded compression connectors with associated gland and shall be constructed of electro-galvanized steel. Fittings utilizing a set screw or indenter tool to secure the associated conduit to the fitting are not acceptable. Couplings and nipples shall be rain-tight and have a plastic insulated throat.

D. Conduit Expansion and Deflection Fittings for use with EMT

1. Conduit expansion fittings and conduit deflection fittings shall be constructed of an electro-galvanized malleable iron alloy which is coated with an acrylic paint finish. Expansion and deflection fittings shall have threaded conduit connections.

2. Expansion fittings shall have an integral bonding jumper and deflection fittings shall have an external bonding jumper.

E. Conduit Termination Fittings for use with EMT

1. Conduit termination fittings shall be constructed of electro-galvanized steel and have a plastic insulated throat. Termination fittings shall have a threaded compression connector with associated gland on one end and external threads on the other end. Termination fittings utilizing a set screw or indenter tool to secure the associated conduit to the fitting are not acceptable.

2. Conduit locknuts shall be constructed of zinc plated steel. Locknuts shall have internal threading. Locknuts shall have integral bonding screw where required for proper bonding.

2.10 CONDUIT BENDS

A. Rigid conduit bends, both factory fabricated and field fabricated, shall meet the same requirements listed in the articles above for the respective conduit type and material of construction.

B. Conduit bend radii for standard radius bends shall be no less than as follows:

TRADE SIZE	¾”	1”	1 ¼”	1 ½”	2”	2 ½”	3”	3 ½”	4”	5”	6”
MIN. RADIUS	4 ½”	5 ¾”	7 ¼”	8 ¼”	9 ½”	10 ½”	13”	15”	16”	24”	30”

C. Conduit bend radii for long radius bends shall be no less than as follows:

TRADE SIZE	¾”	1”	1 ¼”	1 ½”	2”	2 ½”	3”	3 ½”	4”	5”	6”
MIN. RADIUS	N/A	12”	18”	24”	30”	30”	36”	36”	48”	48”	60”

2.11 MISCELLANEOUS

A. Conduit Periphery Sealing

1. The sealing of the exterior surface of conduits to prevent water and/or air from passing around the conduit periphery from one space to another (where required) shall be through the use of one of the following:

a. A conduit sleeve and pressure bushing sealing system. Acceptable products are FSK by OZ-GEDNEY, Link-Seal by Crouse-Hinds, or ENGINEER approved equal.

b. A conduit sleeve that is two trade sizes larger than the conduit being sealed, with 2-hour fire rated UL 1479 Listed caulk filling the entire void between the conduit and sleeve. This method is only suitable for penetrations in non-fire rated walls and floors between spaces within buildings. This method shall not be used for the sealing of conduits leaving a building and/or structure.

2. Conduit penetrations through fire-rated walls and floors shall be made with an approved UL 1479 Listed product specifically intended for the trade size of the conduit.

B. Primer and Cement

1. Nonmetallic conduit shall be cleaned with primer and connected to fittings with the manufacturer's recommended cement that is labeled Low VOC.

C. Galvanizing Compounds

1. Galvanizing compounds for field application shall be the cold-applied type, containing no less than 93% pure zinc.

D. Conduit Interior Sealing

1. The sealing of the inside of conduits against water ingress shall be achieved through the use of one of the following:

a. Two-part expanding polyurethane foam sealing compound, dispensed from a single tube which mixes the two parts as it is injected into the conduit. Expanding foam shall be compatible with the conduit material of construction as well as the outer jacket of the cables in the conduit. Acceptable products are Q-Pak 2000 by Chemque, FST by American Polywater Corporation, or Hydra-seal S-60 by Duraline.

b. Inflatable bag that provides seal around cables and around inside diameter of conduit. Provide appropriate quantity of additional fittings for applications with three or more cables in the conduit to be sealed. Acceptable products are Rayflate by Raychem, or ENGINEER approved equal. This sealing method is only applicable to conduits trade size 2" and larger.

c. Neoprene sealing ring provided with the required quantity and diameter of holes to accommodate the cables in each conduit. Sealing ring shall be compressed by two stainless steel pressure plates. Acceptable products are type CSB by OZ-GEDNEY, or ENGINEER approved equal. This sealing method is only applicable to metallic conduits containing 4 cables or less.

2. The use of aerosol-based expanding foam sealants or any other method of sealing against water ingress not listed above is not acceptable.

E. Pull Rope

1. Pull ropes for empty and spare conduits shall be woven polyester, ½" wide, with a minimum tensile strength of 1250 lbs.

2. Pull ropes for the CONTRACTORs use in installing conductors shall be the size and strength required for the pull, and shall be made of a non-metallic material.

PART 3 – EXECUTION

3.01 GENERAL

A. Minimum trade size for all rigid conduits shall be ¾ inch in exposed applications and 1 inch in embedded applications. Conduits installed within ductbanks shall be allowed to be increased in size to trade size 2 inch, at the CONTRACTOR's option, to accommodate the saddle size of the ductbank spacers. However, no combining of circuits shall be allowed in the larger conduits.

B. Minimum trade size for flexible conduits (where specifically allowed herein) shall be ½ inch in all applications.

C. Conduit routing and/or homeruns within structures is not shown on the Drawings. Conduits shall be installed concealed wherever practical and within the limitations specified herein. All other conduits not capable of being installed concealed shall be installed exposed.

D. Empty and/or spare conduits shall be provided with pull ropes which have no less than 12 inches of slack at each end.

E. Nonmetallic conduits for installations requiring less than a factory length of conduit shall be field cut to the required length. The cut shall be made square, cleaned of debris, and primer shall be applied to ready each joint for fusing. Conduits shall then be fused together with the conduit manufacturer's approved cement compound.

F. Metallic conduits for installations requiring less than a factory length of conduit shall be field cut to the required length. The cut shall be made square, be cleaned of all debris and be de-burred, then threaded. Conduit threading performed in the field shall be ¾ inch per foot tapered threads in accordance with ANSI B1.20.1.

G. Conduits shall be protected from moisture, corrosion, and physical damage during construction. Install dust-tight and water-tight conduit fittings on the ends of all conduits immediately after installation and do not remove until conductors are installed.

H. Conduits shall be installed to provide no less than 12 inches clearance from pipes that have the potential to impart heat upon the conduit. Such pipes include, but are not limited to, hot water pipes, steam pipes, exhaust pipes, and blower air pipes. Clearance shall be maintained whether conduit is installed in parallel or in crossing of pipes.

I. Where non-metallic instrumentation conduits are installed exposed, the following clearances to other conduit types shall be maintained:

1. Instrumentation conduits installed parallel to conduits with conductors energized at 480V or above shall be 18 inches.

2. Instrumentation conduits installed parallel to conduits with conductors energized at 240V and below shall be 12 inches.

3. Instrumentation conduits installed at right angles to conductors energized at 480V and below shall be 6 inches.

4. Instrumentation conduits installed at right angles to conductors energized at voltages above 480V shall be 12 inches.

J. Where conduit fittings installed at termination points do not include an integral insulated bushing, an insulated bushing shall be installed.

K. Conduits which serve multi-section equipment shall be terminated in the section where wiring terminations will be made.

L. Conduits shall not penetrate the floors or walls inside liquid containment areas without specific written authorization from the ENGINEER. Liquid containment areas are indicated on the Drawings.

M. In no case shall conduit be supported or fastened to another pipe or installed to prevent the removal of other pipe for repairs. Spring steel fasteners may only be used to affix conduits containing lighting branch circuits within EMT conduits to structural steel members.

N. All field fabricated threads for EMT, rigid galvanized, or PVC-coated rigid galvanized steel conduit shall be thoroughly coated with two coats of galvanizing compound, allowing at least two minutes to elapse between coats for proper drying.

O. The appropriate specialized tools shall be used for the installation of PVC coated conduit and conduit fittings. No damage to the PVC coating shall occur during installation. Conduit and conduit fittings with damaged PVC coating shall be replaced at the CONTRACTOR's cost. The use of PVC coating touch-up compounds is not permitted.

P. Conduits which emerge from within or below concrete encasement shall be PVC coated rigid galvanized steel in accordance with Standard Detail 1611102 where the conduit is not protected by an equipment enclosure that surrounds the conduit on all sides at the point where it emerges from the encasement.

Q. Aluminum conduits shall not be installed in direct contact with concrete surfaces. Where aluminum conduits are routed along concrete surfaces, they shall be installed with one-hole electro-galvanized malleable iron alloy straps with matching clamp-backs to space

the conduit ¼ inch away from concrete surface. Where aluminum conduit passes through concrete, CMU or brick walls, the penetration shall be made such that the aluminum conduit does not come in contact with concrete, CMU, brick or mortar.

3.02 CONCEALED AND EMBEDDED CONDUITS

A. Conduits are permitted to be installed concealed and/or embedded with the following requirements:

1. Conduits shall not be installed horizontally when concealed within CMU walls, only vertical installation is acceptable.

2. Conduits installed embedded within concrete floors or walls shall be located so as not to affect the designed structural strength of the floor or wall. Embedded conduits shall be installed in accordance with Standard Detail 0331604 and ACI-318.

3. Where conduit bends emerge from concrete embedment, none of the curved portion of the bend shall be visible. Only the straight portion of the bend shall be visible.

4. Where multiple conduits emerge from concrete embedment or from concealment below a concrete floor, ample clear space shall be provided between conduits to allow for the appropriate and required conduit termination fittings to be installed.

5. Conduits installed embedded within concrete encasement of any kind shall be installed such that conduit couplings for parallel conduits are staggered so that they are not side by side.

B. Conduits are NOT permitted to be installed concealed and/or embedded for the following situations:

1. Conduits shall not be installed embedded within any water-bearing floors or walls. Conduits shall not be installed embedded within any liquid containment area floors or walls.

2. Conduits shall not be installed concealed within CMU walls or gypsum walls that are adjacent to Class I and II hazardous areas (Division I and Division II).

3. Conduits shall not be installed concealed within CMU walls or gypsum walls that are adjacent to indoor Type 1 or Type 2 chemical storage/transfer areas.

3.03 CONDUIT USES AND APPLICATIONS

A. Rigid Conduit

1. Rigid conduit for non-hazardous areas shall be furnished and installed in the materials of construction as follows:

RIGID CONDUIT FOR NON-HAZARDOUS AREAS		
INSTALLATION AREA DESIGNATION/ SCENARIO	CONDUIT CATEGORY BY WIRING/CIRCUIT TYPE	
	Power and Control	Instrumentation
Exposed in indoor wet process areas	Rigid aluminum conduit	PVC coated rigid galvanized steel conduit
Exposed in indoor dry process areas	Rigid aluminum conduit	PVC coated rigid galvanized steel conduit
Exposed in indoor dry non-process areas	Rigid galvanized steel conduit	Same as Power and Control
Exposed in Type 1 chemical storage/transfer areas	Schedule 80 rigid non-metallic PVC conduit	Same as Power and Control
Exposed in Type 2 chemical storage/transfer areas	Rigid aluminum conduit	Same as Power and Control
Exposed in outdoor areas	Rigid aluminum conduit	PVC coated rigid galvanized steel
Exposed within pre-fabricated electrical equipment center buildings	Electrical Metallic Tubing	Same as Power and Control
Concealed within underground direct-bury or concrete-encased ductbanks	Schedule 40 rigid non-metallic PVC conduit	PVC coated rigid galvanized steel conduit
Concealed within non-elevated (i.e. "slab-on-grade" construction) concrete slabs	Schedule 40 rigid non-metallic PVC conduit	Rigid galvanized steel conduit
Concealed within elevated concrete slabs	Rigid galvanized steel conduit	Same as Power and Control
Concealed below concrete slabs (within earth or fill material)	Schedule 40 rigid non-metallic PVC conduit	PVC coated rigid galvanized
Concealed within concrete walls	Schedule 40 rigid non-metallic PVC conduit	Rigid galvanized steel conduit
Concealed within CMU walls	Schedule 40 rigid non-metallic PVC conduit or Electrical Metallic Tubing	Rigid galvanized steel conduit or Electrical Metallic Tubing
Concealed above suspended ceilings	Electrical Metallic Tubing	Same as Power and Control
Concealed within interior walls constructed of metal studs and gypsum wall board	Electrical Metallic Tubing	Same as Power and Control
Emerging from concealment within or below a concrete floor and transitioning to exposed conduit (Reference Detail 1611102)	PVC coated rigid galvanized steel conduit	Same as Power and Control

2. Rigid conduit for hazardous areas shall be furnished and installed in the materials of construction as follows:

RIGID CONDUIT FOR HAZARDOUS AREAS		
	CONDUIT CATEGORY BY WIRING/CIRCUIT TYPE	
INSTALLATION AREA HAZARD/SCENARIO	**Power and Control**	**Instrumentation**
Exposed in indoor dry Class I and II areas (Division I and Division II)	Rigid aluminum conduit	Rigid galvanized steel conduit
Exposed in indoor wet Class I and II areas (Division I and Division II)	Rigid aluminum conduit	PVC coated rigid galvanized steel conduit
Exposed in outdoor Class I and II areas (Division I and Division II)	Rigid aluminum conduit	PVC coated rigid galvanized steel conduit
Concealed within concrete slabs in Class I and II areas (Division I and Division II)	Rigid galvanized steel conduit	Same as Power and Control
Concealed below concrete slabs (within earth or fill material) in Class I and II areas (Division I and Division II)	Rigid galvanized steel conduit	Same as Power and Control
Concealed within concrete walls in Class I and II areas (Division I and Division II)	Rigid galvanized steel conduit	Same as Power and Control
Concealed below concrete slabs encased in at least two inches of concrete and buried 24 inches below top of slab in Class I Division I areas	Schedule 40 rigid non-metallic PVC conduit	Rigid galvanized steel conduit
Concealed above suspended ceilings in Class I and II areas (Division I and Division II)	Rigid aluminum conduit	Rigid galvanized steel conduit

3. The tables for the materials of construction for conduits in non-hazardous and hazardous areas are intended to exhaustively cover all possible scenarios and installation areas under this Contract. However, if a scenario or installation area is found that is not explicitly governed by these tables, it shall be assumed for bid purposes that the conduit material of construction is to be rigid galvanized steel. This discrepancy shall be brought to the attention of the ENGINEER (in writing) immediately for resolution.

B. Conduit Bends

1. All conduit bends shall be the same material of construction as the rigid conduit listed in the tables above, with the following exceptions:

   a. All 90 degree bends or combinations of adjacent bends that form a 90 degree bend where concealed within concrete or below a concrete slab shall be PVC coated rigid galvanized steel.

2. Field fabricated bends of metallic conduit shall be made with a bending machine and shall have no kinks. Field fabricated standard radius and long radius bends shall have minimum bending radii in accordance with the associated tables in Part 2 herein.

3. Field bending of non-metallic conduits is not acceptable, factory fabricated bends shall be used.

4. Long radius bends shall be furnished and installed for the following specific applications, all other bends shall be standard radius:

   a. All conduits containing medium voltage cable.
   b. All conduits containing fiber optic cable.
   c. All conduits containing shielded VFD cable.
   d. Where specifically indicated on the Drawings.

C. Flexible Conduit

1. Flexible conduit shall only be installed for the limited applications specified herein. Flexible conduit shall not be installed in any other application without written authorization from the ENGINEER. Acceptable applications are as follows:

   a. Connections to motors and engine-generator sets (and similar vibrating equipment)
   b. Connections to solenoid valves and limit switches
   c. Connections to lighting fixtures installed in suspended ceilings
   d. Connections to lighting transformers
   e. Connections to pre-fabricated equipment skids
   f. Connections to HVAC equipment
   g. Connections to instrument transmitters and elements
   h. Where specifically indicated in the Standard Details

2. Flexible conduit length shall be limited to three (3) feet, maximum. Flexible conduit shall not be installed buried or embedded within any material.

3. Flexible conduit for non-hazardous areas shall be furnished and installed in the materials of construction as follows:

FLEXIBLE CONDUIT FOR NON-HAZARDOUS AREAS		
INSTALLATION AREA DESIGNATION/SCENARIO	**CONDUIT CATEGORY BY WIRING/CIRCUIT TYPE**	
	Power and Control	**Instrumentation**
Exposed in indoor wet process areas	Liquid-tight flexible metal conduit	Same as Power and Control

Exposed in indoor dry process areas	Liquid-tight flexible metal conduit	Same as Power and Control
Exposed in indoor dry non-process areas	Flexible metal conduit	Same as Power and Control
Exposed in indoor Type 1 chemical storage/transfer areas	Liquid-tight flexible non-metallic conduit	Same as Power and Control
Exposed in indoor Type 2 chemical storage/transfer areas	Liquid-tight flexible non-metallic conduit	Same as Power and Control
Exposed in outdoor areas	Liquid-tight flexible metal conduit	Same as Power and Control
Concealed above suspended ceilings (all indoor areas)	Flexible metal conduit	Same as Power and Control

4. For Class I Division I hazardous areas, the NEC does not permit the installation of flexible conduit. In lieu of flexible conduit in these areas, flexible conduit couplings shall be installed as specified in Part 2 herein. Flexible conduit for all other hazardous areas shall be furnished and installed in the materials of construction as follows:

FLEXIBLE CONDUIT FOR HAZARDOUS AREAS		
INSTALLATION AREA HAZARD/SCENARIO	**CONDUIT CATEGORY BY WIRING/CIRCUIT TYPE**	
	Power and Control	**Instrumentation**
Exposed in Class I Division II areas	Liquid-tight flexible metal conduit	Same as Power and Control
Exposed in Class II (Division I and Division II) areas	Liquid-tight flexible metal conduit	Same as Power and Control
Concealed above suspended ceilings in Class I and II (Division I and Division II) areas	Same material as exposed conduit in same area	Same as Power and Control

3.04 CONDUIT FITTING USES AND APPLICATIONS

A. General

1. Conduit fittings shall be furnished and installed in the materials of construction as indicated in Part 2, herein. Conduit fitting materials of construction are dependent on the material of construction used for the associated conduit.

2. Conduit fittings shall be provided in the trade size and configuration required to suit the application.

B. Conduit Bodies

1. Conduit bodies shall be installed where wire pulling points are desired or required, or where changes in conduit direction or breaking around beams is required.

2. Where conduit bodies larger than trade size 2 inches are intended to be used as a pull-through fitting during wire installation, oversized or elongated conduit bodies shall be used. Oversized or elongated conduit bodies shall not be required if the conduit body is intended to be used as a pull-out point during wire installation.

C. Conduit Nipples and Unions

1. Conduits with running threads shall not be used in place of 3-piece couplings (unions) or close nipples. After installation of a conduit fitting of any kind, there shall be no more than ¼ inch of exposed threads visible. Factory fabricated all-thread nipples may be used between adjacent enclosures, however, the same restriction applies regarding the length of exposed threads that are visible.

D. Conduit Expansion and Deflection Fittings

1. Conduit expansion fittings shall be installed where required by the NEC and where indicated on the Drawings. Expansion fittings shall also be installed for exposed straight metallic conduit runs of more than 75 feet, in both indoor and outdoor locations. Expansion fittings for runs of non-metallic conduit shall be installed in accordance with the NEC.

2. Conduit deflection fittings shall be installed where required by the NEC and where conduits are installed (exposed and concealed) across structural expansion joints.

E. Conduit Seals

1. Conduit seals shall be installed for conduits installed within or associated with hazardous areas and other areas as required by the NEC. In addition, conduit seals shall also be furnished and installed as follows:

   a. All conduits entering or leaving enclosed areas which store or distribute chlorine gas.
   b. All conduits entering or leaving enclosed areas which store or distribute sulfur dioxide gas.

F. Conduit Termination Fittings

1. Where conduits terminate at enclosures with a NEMA 4, 4X, or 3R rating and the enclosure does not have integral conduit hubs, an appropriately sized watertight conduit hub shall be installed to maintain the integrity of the enclosure. The use of locknuts with integral gasket in lieu of watertight conduit hubs is not acceptable.

2. Where conduits terminate at enclosures that do not require conduit hubs, a two-locknut system shall be used to secure the conduit to the enclosure. One locknut

shall be installed on the outside of the enclosure, and the other inside, drawn tight against the enclosure wall. The locknut on the interior of the enclosure shall be the type with integral bonding lug, or a conduit bonding bushing may be used in place of the locknut.

3. Conduits shall not be installed such that conduit fittings penetrate the top of any enclosure located outdoors, except in cases where specifically required by the serving electric utility. Conduits which serve outdoor equipment or an enclosure from above shall instead be routed into the side of the enclosure at the bottom. The conduit termination fitting shall be provided with a conduit drain to divert moisture from the raceway away from the enclosure.

3.05 MISCELLANEOUS

A. Conduit Periphery Sealing

1. All conduit penetrations through exterior walls shall be sealed around the periphery using the appropriate products specified in Part 2 herein to prevent air and/or water entry into the structure.

2. All conduit penetrations through interior walls and floors shall be sealed through the use of with conduit sleeves and caulk as specified in Part 2 herein. Alternatively, mortar may be used to seal around the conduit periphery.

3. Conduit penetrations through fire-rated walls as floors shall be made with the appropriate fire rated penetration product.

B. Conduit Interior Sealing

1. All conduits (including spares) entering a structure below grade shall be sealed on the interior of the conduit to prevent water ingress. Sealing shall be at an accessible location in the conduit system located within the building structure and shall be via one of the methods specified in Part 2 herein. If conduit sealing cannot be achieved at an accessible location within the building structure, sealing shall be placed in the conduits in the nearest manhole or handhole outside the structure.

3.06 CONDUIT IDENTIFICATION

A. Exposed conduits shall be identified at the source, load, and all intermediate components of the raceway system. Examples of intermediate components include but are not limited to junction boxes, pull boxes, and disconnect switches. Identification shall be by means of an adhesive label with the following requirements:

1. Labels shall consist of an orange background with black text.

2. At the source end of the conduit, the text shall indicate the load equipment name. This line shall consist of the word “TO:” and the text in the ‘TO’ column of the conduit and wire schedule or as called out on the single line and riser diagrams (e.g. TO: Raw Sewage Pump No. 1). At the load end of the conduit, the text shall 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 or as called out on the single line and riser diagrams (e.g. FROM: MCC-SPS). This requirement applies only to the source and load ends of the conduit, and not anywhere in between.

3. At intermediate components of the raceway system, the label shall consist of two lines of text. The first shall indicate the source of the conduit, as described above. The second shall indicate the load, as described above.

4. For conduits trade sizes ¾" through 1½", the text shall be a minimum 18 point font. For conduits trade size 2" and larger, the text shall be a minimum 24 point font.

5. Label height shall be ¾" 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.

6. 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.

7. Labels shall be made of permanent vinyl with adhesive backing. Labels made of any other material are not acceptable.

B. Conduits that are not exposed but installed beneath free standing equipment enclosures shall be identified by means of a plastic tag with the following requirements:

1. The tag shall be made of white Tyvek material, and have an orange label with black text, as described above, adhered to it. Text for the label shall be as specified in subparagraph A-2 above.

2. The tag shall be affixed to the conduit by means of a nylon cable tie. The tag shall be of suitable dimensions to achieve a minimum text size of 18 points.

C. Conduits for lighting and receptacle circuits shall not require identification.

D. Any problems or conflicts with meeting the requirements above shall immediately be brought to the attention of the ENGINEER for a decision.

3.07 TESTING

A. All tests shall be performed in accordance with the requirements of the Public Utilities General Conditions and Division 1. The following tests are required:

1. All conduit installed below grade or concrete encased shall be tested to ensure continuity and the absence of obstructions by pulling through each conduit a swab

followed by a mandrel 85% of the conduit inside diameter. After testing, all conduits shall be capped after installation of a suitable pulling rope.

3.08 TRAINING OF INSTALLATION PERSONNEL

A. All CONTRACTOR personnel that install PVC coated RGS conduit shall be trained by the PVC coated RGS conduit manufacturer. Training shall include proper conduit system assembly techniques, use of tools appropriate for coated conduit systems, and field bending/cutting/threading of coated conduit. Training shall have been completed within the past 24 months prior to the Notice to Proceed on this Contract to be considered valid. CONTRACTOR personnel not trained within this timeframe shall not be allowed to install coated conduit, or shall be trained/re-trained as required prior to commencement of conduit installation.

- END OF SECTION -

SECTION 16123 – LOW VOLTAGE WIRE AND CABLE

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The CONTRACTOR shall furnish, install, connect, test, and place in satisfactory operating condition, all low voltage wire and cable indicated on the Drawings and as specified herein and/or required for proper operation. The work of connecting cables to equipment and devices shall be considered a part of this Section. All appurtenances required for the installation of cable and wire systems shall be furnished and installed by the CONTRACTOR.

B. The scope of this Section does not include internal wiring factory installed by electrical equipment manufacturers.

C. Reference Section 16000 - Basic Electrical Requirements; Section 16111 - Conduit; and Section 16130 - Boxes.

1.02 SUBMITTALS

A. In accordance with the procedures and requirements set forth in the Public Utilities 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 Field Tests

3. Wiring Identification Methods

B. 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 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 (if required).

3. Wiring identification methods and materials.

1.04 IDENTIFICATION

A. Each cable shall be identified as specified in Part 3, Execution, of this Specification.

1.05 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 to be furnished and installed for this project shall be the product of manufacturers who have been in the business of manufacturing wire and cable for a minimum of ten (10) years. Wire and cable shall be designed, constructed and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as specified herein and indicated on the Drawings. 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 POWER WIRE AND CABLE

A. Power cable and wire installed between the output terminals of a VFD and the respective motor shall consist of stranded copper conductor with insulation type XHHW/XHHW-2, rated 90°C and 600V.

B. Power cable and wire shall consist of stranded, copper conductor with insulation type THHN/THWN-2, rated 90°C for dry locations and 75°C for wet locations.

C. Conductors shall be stranded copper per ASTM-B8 and B-3, and Class B or C stranding contingent on the size unless otherwise specified. Minimum size wire shall be No. 12 AWG.

D. Multi-conductor power cable assemblies shall be UL 1277 Listed, provided with a bonding conductor, and furnished with an overall PVC jacket.

E. Power wire and cable shall be as manufactured by the Okonite Company, the Southwire Company, General Cable, or equal.

2.03 CONTROL CABLE

A. 600 volt control cable shall consist of stranded, copper conductor with insulation type THHN/THWN-2, rated 90°C in dry locations and 75°C in wet locations.

B. Conductors shall be stranded copper per ASTM B-8 and B-3, and Class B or C stranding contingent on the size unless otherwise specified. Minimum wire size shall be No. 14 AWG.

C. Multi-conductor control cable assemblies shall be UL 1277 Listed, provided with a bonding conductor, and furnished with an overall PVC jacket.

D. Control cable shall be as manufactured by the Okonite Company, the Southwire Company, General Cable, or equal.

2.04 LIGHTING AND RECEPTACLE WIRE

A. The lighting and receptacle branch circuit wire shall consist of stranded, copper conductors with insulation type THHN/THWN-2, rated 90°C in dry locations and 75°C for in wet locations.

B. Conductors shall be stranded copper. Minimum size power wiring shall be No. 12 AWG.

C. Lighting and receptacle wire shall be as manufactured by the Okonite Company, the Southwire Company, General Cable, 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 75°C (minimum) 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, Belden equivalent, Southwire Company equivalent, or equal.

2.06 SHIELDED VFD CABLE

A. Where indicated on the Drawings, shielded VFD cable shall be provided for motors controlled by VFDs. The cable shall be 2000V rated, with stranded tinned copper conductors, shielded, suitable for use with variable frequency drives. Cable shall be suitable for use in wet/dry locations, indoors and outdoors, in cable trays, in conduits, trenches, and in underground ducts and direct burial. The conductor shall be annealed stranded tinned copper per ASTM B3, B8, and B33.

B. The insulation shall be rated for 90 degrees Celsius Wet/Dry operating temperature. The insulation material shall be XLPE with a XHHW-2 listing per UL 44. The insulated conductors shall be cabled together with three (3) symmetrically placed ground wires. The ground wires shall have a minimum circular mil area equivalent to one circuit conductor. Fillers shall be included as necessary to make the cable round.

C. The cabled assembly shall be shielded by applying helically a 5 mil copper tape. The shield shall provide 100% coverage over the assembly. All cables shall have a continuous

overall outer jacket of Polyvinyl Chloride (PVC), suitable for 90°C use. The jacket shall be resistant to abrasion, rated for direct burial, sunlight resistant and flame resistant in accordance with UL 1277. Cable shall be as manufactured by Belden Wire and Cable, Okonite, General Cable, or AmerCable Inc.

2.07 CONDUCTOR IDENTIFICATION

A. Conductors shall be identified using a color coding method. Color coding for individual power, control, lighting, and receptacle conductors shall be as follows:

1. 480/277V AC Power
   Phase A BROWN
   Phase B ORANGE
   Phase C YELLOW
   Neutral GREY

2. 120/208V or 120/240V AC Power
   Phase A BLACK
   Phase B RED
   Phase C BLUE
   Neutral WHITE

3. DC Power
   Positive Lead RED
   Negative Lead BLACK

4. DC Control
   All wiring - BLUE

5. 120VAC Control
   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 interlock conductor shall be color coded YELLOW.

6. 24VAC Control
   All wiring - ORANGE

7. Equipment Grounding Conductor
   All wiring - GREEN

B. Individual conductors No. 2 AWG and smaller shall have factory color coded insulation. It is acceptable for individual conductors larger than No.2 AWG to be provided with factory color coded insulation as well, but it is not required. Individual conductors larger than No.2 AWG that are not provided with factory color coded insulation shall be identified by the use of colored tape in accordance with the requirements listed in Part 3 herein. Insulation colors and tape colors shall be in accordance with the color coding requirements listed above.

C. Conductors that are a part of multi-conductor control cable assemblies shall have black insulation. The conductor number shall be printed on each conductor's insulation in accordance with ICEA S-58-679, Method 4. Each conductor within the cable assembly shall also be identified with a heat shrink tag with color coded background in accordance

with the requirements listed in Part 3 herein. Background color shall be in accordance with the color coding requirements listed above.

D. Conductors that are a part of multi-conductor power cable assemblies shall have black insulation. The conductor number shall be printed on each conductor's insulation in accordance with ICEA S-58-679, Method 4. Each conductor No.2 AWG and smaller within the cable assembly shall also be identified with a heat shrink tag with color coded background. Each conductor larger than No.2 AWG within the cable assembly shall also be identified by the use of colored tape. Heat shrink tags and colored tape shall be in accordance with the requirements listed in Part 3 herein. Tape color and heat shrink tag background color shall be in accordance with the color coding requirements listed above.

2.08 CABLE PULLING LUBRICANTS

A. Cable pulling lubricants shall be non-hardening type and approved for use on the type of cable installed. Lubricant shall be Yellow #77 Plus by Ideal, Cable Gel by Greenlee, Poly-Gel by Gardner Bender, or equal.

PART 3 – EXECUTION

3.01 POWER, CONTROL, AND LIGHTING/RECEPTACLE WIRE AND CABLE INSTALLATION

A. The wire and cable 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 concrete box 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) shall only be permitted for lighting and receptacle circuits.

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 from source to load does not exceed 3%.

F. Additional Conductor Identification

1. In addition to the color coding identification requirements specified in Part 2 herein, individual conductors shall be provided with heat shrinkable identification tags. Identification tags for individual conductors shall have a white background where the conductor insulation is colored. Identification tags for individual conductors shall have

a colored background where the conductor insulation is black. Background color shall match that of the taping provided on the individual black conductors.

2. Multi-conductor cables shall be provided with heat shrinkable identification tags in accordance with Part 2 herein.

3. All wiring shall be identified at each point of termination. This includes but is not limited to identification at the source, load, and in any intermediate junction boxes where a termination is made. The CONTRACTOR shall meet with the Owner and ENGINEER to come to an agreement regarding a wire identification system prior to installation of any wiring. Wire numbers shall not be duplicated.

4. Wire identification shall be by means of a heat shrinkable sleeve with appropriately colored background and black text. Wire sizes #14 AWG through #10 AWG shall have a minimum text size of 7 points. Wire sizes #8 AWG and larger shall have a minimum text size of 10 points. Sleeves shall be of appropriate length to fit the required text. The use of handwritten text for wire identification shall not be permitted.

5. Sleeves shall be suitable for the size of wire on which they are installed. Sleeves shall not be heat-shrunk onto control cables. Tags shall remain loose on cable to promote easier identification. For all other applications, sleeves shall be tightly affixed to the wire and shall not move. Sleeves shall be heat shrunk onto wiring with a heat gun approved for the application. Sleeves shall not be heated by any means which employs the use of an open flame. The CONTRACTOR shall take special care to ensure that the wiring insulation is not damaged during the heating process.

6. Sleeves shall be installed prior to the completion of the wiring terminations and shall be oriented so that they can be easily read.

7. Sleeves shall be polyolefin as manufactured by Brady, Seton, Panduit, or equal.

8. Wire identification in manholes, handholes, pull boxes, and other accessible components in the raceway system where the wiring is continuous (no terminations are made) shall be accomplished by means of a tag installed around the bundled group of individual conductors or around the outer conductor jacket of a multi-conductor cable. Identification shall utilize a FROM-TO system. Each group of conductors shall consist of all 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, Panduit, or equal.

9. Where colored tape is used to identify cables, it shall be wrapped around the cable with a 25% overlap and shall cover at least 2 inches of the cable.

G. 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.

H. 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. In training or racking, the radius of bend of any cable shall be not less than the manufacturer's recommendation. The training shall be done in such a manner as to minimize chaffing.

2. Instrumentation cable shall be racked separate from other AC and DC wiring to maintain the required separation as follows:

   a. 18 inches for 480/277VAC wiring

   b. 12 inches for 208/120VAC wiring

   c. 6 inches for 24VDC wiring

I. Conductor Terminations

1. Where wires are terminated at equipment which requires lugs, connections shall be made by solderless mechanical lug, crimp type ferrule, or irreversible compression type lugs. Reference individual equipment specification sections as applicable for additional termination requirements.

2. Where enclosure sizes and sizes of terminals at limit switches, solenoid valves, float switches, pressure switches, temperature switches, and other devices make terminations impractical due to the size of the field wiring, the CONTRACTOR shall terminate field wiring in an adjacent junction per the requirements of Section 16130 - Boxes, complete with terminal strips. CONTRACTOR shall install the smaller wiring from the device to the junction box in a conduit, using the terminal strip as the means for joining the two different wire sizes. Splicing of wires in lieu of using terminal strips is not acceptable.

3. All spare conductors shall be terminated on terminal blocks mounted within equipment or junction boxes. Unless otherwise noted, coiling up of spare conductors within enclosure is not acceptable.

J. 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.

3.02 INSTRUMENTATION CABLE INSTALLATION

A. The CONTRACTOR shall install all cable or conductors used for instrumentation wiring (4 20 mA DC, etc.) in conduit as specified in Section 16111 - Conduit. Only instrumentation cable as specified herein 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.

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. Special instrument cable shall be as specified or recommended by the manufacturer of the equipment or instruments requiring such wiring. Installation, storage, and terminations, shall be per manufacturer's recommendations.

3.03 SHIELDED VFD CABLE INSTALLATION

A. The CONTRACTOR shall install all cable or conductors used for shielded VFD cable in conduit as specified in Section 16111 - Conduit. Only shielded VFD cable as specified herein shall exclusively occupy these conduits. No other wiring shall be installed in these conduits.

3.04 FIBER OPTIC CABLE INSTALLATION

A. The CONTRACTOR shall install the fiber optic cable furnished by the General CONTRACTOR and/or the Instrumentation and Control Subcontractor. 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. Prior to installation, the cable shall be tested on the reel to ensure integrity. The cable shall be tested immediately after installation to verify the integrity of the newly installed cable. Reference Division 17 for additional information regarding the fiber optic cable.

3.05 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. 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.

2. Field Tests

a. After installation, all wires and cables shall be tested for continuity. Testing for continuity shall be “test light” or “buzzer” style.

b. After installation, some wires and cables shall be tested for insulation levels. 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 #8 AWG and larger 600V power and control cable, apply 1,000 VDC from a Megaohmeter for one (1) minute for all 600V wires and cables installed in lighting, control, power, indication, alarm and motor feeder circuits. Resistance shall be no less than 100 Megaohms. Insulation testing is not required for power and control cables smaller than #8 AWG.

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. Wires and cables shall be tested before being connected to motors, devices or terminal blocks.

C. If tests reveal defects or deficiencies, the CONTRACTOR shall make the necessary repairs or shall replace the cable as directed by the ENGINEER, without additional cost to the Owner.

D. 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.

- - END OF SECTION - –

(EXHIBIT A)
TEST DATA - MEGOHMS
TEST NO. ____

Date:			Company:				
Time:			Location:				
Circuit:	Circuit Length:	Aerial:	Duct:	Buried:	No. of Conduc-tors	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
□ Minute				5 Minutes			
□ 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:

SECTION 16130 – BOXES

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The scope of work under this Section includes furnishing and installing all pull boxes, junction boxes, and outlet boxes.

B. Requirements for other boxes and enclosures are not included in this Section. Refer to each specific Division 16 equipment Section for requirements related to that equipment's respective enclosure.

C. Reference Section 16000, Basic Electrical Requirements, and Section 161111, Conduit.

1.02 CODES AND STANDARDS

A. Boxes shall be designed, manufactured, and/or listed to the following standards as applicable:

1. UL 514A - Metallic Outlet Boxes

2. UL 514C - Standard for Non-metallic Outlet Boxes, Flush Device Boxes, and Covers

3. UL 50 – Enclosures for Electrical Equipment, Non-environmental Considerations

4. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations

5. UL 1203 – Standard for Explosion-proof and Dust-ignition-proof Electrical Equipment for use in Hazardous (Classified) Locations.

6. NEMA 250 – Enclosures for Electrical Equipment

1.03 SUBMITTALS

A. In accordance with the procedures and requirements set forth in the Public Utilities 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 for boxes, terminal strips, and all accessories

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 Public Utilities General Conditions and Division 1.

B. As-built drawings showing dimensions, internal box layout, terminal strip information, and terminal strip identification information shall be provided for all junction boxes. As-built drawings are not required for pull boxes or outlet boxes.

1.06 IDENTIFICATION

A. Each pull and junction box shall be identified with the box name as indicated on the Contract Drawings (e.g. PPB-XXX, CJB-YYY) or as directed by the ENGINEER. A nameplate shall be securely affixed in a conspicuous place on each box. Nameplates shall be as specified in Section 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.

2.02 PULL AND JUNCTION BOXES

A. General

1. All pull and junction boxes shall be UL listed and labeled.

2. Pull and junction boxes shall not be provided with eccentric or concentric knockouts.

3. Pull and junction boxes mounted embedded in concrete shall be UL listed for embedment.

4. Where metallic boxes are used, they shall be of all welded construction. Tack welded boxes are not acceptable.

B. Pull Boxes

1. All pull boxes shall be provided with a matching gasketed cover. For covers with dimensions of 24 inches by 24 inches or less, the cover shall be held in place by machine screws. Other screw types are not acceptable. For covers with dimensions greater than 24 inches by 24 inches, the cover shall be hinged and held in place by screw-operated clamp mechanisms. Hinge pins shall be removable. Clamp mechanism material of construction shall match that of the associated box.

2. Pull boxes shall not have any wire terminations inside, other than those for grounding/bonding. A ground bar shall be provided with the necessary number of screw type terminals. Twenty (20) percent of the total amount of terminals otherwise required for the pull box (minimum of two) shall be provided as spare terminations. Boxes requiring any other wire terminations shall be furnished and installed in accordance with the requirements for junction boxes herein.

3. Pull boxes shall be 6 inches wide by 6 inches tall by 4 inches deep, minimum. For applications requiring larger boxes, the box shall be sized in accordance with the fill requirements and dimensional requirements of the NEC.

4. Barriers shall be provided in pull boxes to isolate conductors of different voltages, types, and functions. Barrier material of construction shall match that of the box. Isolation shall be provided between the following groups:

    a. Power wiring

    b. AC control wiring

    c. DC control wiring

    d. Instrumentation wiring

C. Junction Boxes

1. Junction boxes used for lighting and receptacle circuits only shall be provided with a matching gasketed cover held in place by machine screws. Other screw types are not acceptable.

2. Junction boxes for all uses other than lighting and receptacle circuits shall be provided with a hinged, gasketed cover. Hinge pins shall be removable. Cover shall be held in place by screw-operated clamp mechanisms. Clamp mechanism material of construction shall match that of the associated box.

3. Barriers shall be provided in junction boxes to isolate conductors and terminal blocks of different voltages, types, and functions. Barrier material of construction shall match that of the box. Isolation shall be provided between the following groups:

    a. Power wiring

    b. AC control wiring

c. DC control wiring

d. Instrumentation wiring

4. Junction boxes used for lighting and receptacle circuits only shall be allowed to have screw-on (wire nut) type connectors for wire terminations/junctions.

5. Junction boxes for all uses other than lighting and receptacle circuits shall be provided with terminal strips, consisting the necessary number of screw type terminals. Current carrying parts of the terminal blocks shall be of ample capacity to carry the full load current of the circuits connected, with a 10A minimum capacity. Terminal strips shall be rated for the voltage of the circuits connected. A separate ground bar shall be provided with the necessary number of screw type terminals. Twenty (20) percent of the total amount of terminals otherwise required for the junction box (minimum of two) shall be provided as spare terminations. When barriers are provided within the box, separate terminal strips shall be provided in each barrier area. Terminals shall be lettered and/or numbered to conform to the wiring labeling scheme in place on the project.

6. Junction boxes shall be 6 inches wide by 6 inches tall by 4 inches deep, minimum. For applications requiring larger boxes, the box shall be sized in accordance with the fill requirements and dimensional requirements of the NEC. Terminal blocks (including spare terminals) shall be considered when sizing the junction box.

D. Enclosure Types and Materials

1. In non-hazardous locations, pull and junction boxes shall be furnished with the following enclosure type and material of construction, dependent upon the designation of the area in which they are to be installed. Area designations are indicated on the Drawings. Where enclosure types and materials are called out on the drawings however, provide enclosure type and material as indicated on the drawing.

AREA DESIGNATION	**ENCLOSURE TYPE AND MATERIAL**
Indoor Wet Process Area	NEMA 4X, Type 316 Stainless Steel
Indoor Dry Process Area	NEMA 12, Painted Steel
Indoor Dry Non-process Area	NEMA 1, Painted Steel
Type 1 Chemical Storage/Transfer Area	NEMA 4X, Fiberglass or PVC
Type 2 Chemical Storage/Transfer Area	NEMA 4X, Type 316 Stainless Steel
All Outdoor Areas	NEMA 4X, Type 316 Stainless Steel

2. In hazardous locations, pull and junction boxes shall be furnished with the following enclosure type and material of construction, dependent upon the classification of the area in which they are to be installed. Area classifications are indicated on the Drawings.

AREA CLASSIFICATION	**ENCLOSURE TYPE AND MATERIAL**
Class 1, Division 1, Group D	NEMA 7, Die Cast Aluminum

Class 1, Division 2, Group D	NEMA 4X, Type 316 Stainless Steel
Class 2, Division 1, Group F	NEMA 9, Die Cast Aluminum
Class 2, Division 2, Group F	NEMA 4X, Type 316 Stainless Steel

3. Non-metallic enclosures, NEMA 7 enclosures, and NEMA 9 enclosures shall be provided with threaded integral conduit hubs.

2.03 OUTLET BOXES

A. General

1. Outlet boxes shall be provided with a trim appropriate for the wiring device installed inside. Refer to Section 16141, Wiring Devices, for outlet box trim requirements. An appropriate outlet box trim is required to achieve the NEMA rating of the outlet boxes as specified herein.

B. Surface Mount Outlet Boxes

1. Outlet boxes shall be the deep type, no less than 2.5 inches deep.

2. Outlet boxes shall be provided in single or multi-gang configuration as required, sized in accordance with the requirements of the NEC.

3. In non-hazardous locations, outlet boxes shall be furnished with the following enclosure type and material of construction, dependent upon the designation of the area in which they are to be installed. Area designations are indicated on the Drawings. Where enclosure types and materials are called out on the drawings however, provide enclosure type and material as indicated on the drawing.

AREA DESIGNATION	**ENCLOSURE TYPE AND MATERIAL**
Indoor Wet Process Area	NEMA 4X, Cast Aluminum
Indoor Dry Process Area	NEMA 1, Cast Aluminum
Indoor Dry Non-process Area	NEMA 1, Cast Aluminum
Type 1 Chemical Storage/Transfer Area	NEMA 4X, PVC
Type 2 Chemical Storage/Transfer Area	NEMA 4X, Cast Aluminum
All Outdoor Areas	NEMA 4X, Cast Aluminum

4. In hazardous locations, outlet boxes shall be furnished with the following enclosure type and material of construction, dependent upon the classification of the area in which they are to be installed. Area classifications are indicated on the Drawings.

AREA CLASSIFICATION	**ENCLOSURE TYPE AND MATERIAL**
Class 1, Division 1, Group D	NEMA 7, Die Cast Aluminum
Class 1, Division 2, Group D	NEMA 4X, Cast Aluminum
Class 2, Division 1, Group F	NEMA 9, Die Cast Aluminum
Class 2, Division 2, Group F	NEMA 4X, Cast Aluminum

C. Outlet boxes shall be provided with integral threaded conduit hubs mounted external to the box. Boxes with threaded conduit hubs mounted internal to the box or as a part of the box wall are not acceptable.Flush Mount Outlet Boxes

1. Outlet boxes shall be no less than 2-1/8 inches deep, and 4-11/16 inches square. Boxes shall be UL listed and labeled. Pre-punched single diameter conduit knockouts are acceptable; however, concentric and eccentric knockouts are not acceptable.

2. Outlet boxes mounted flush in CMU walls shall be made of galvanized, tack welded steel, and suitable for installation in masonry walls. Sectional type boxes are not acceptable for this application.

3. Outlet boxes mounted flush in gypsum walls shall be made of galvanized pressed steel. Tack welded boxes are not acceptable for this application. Sectional type boxes are not acceptable for this application.

4. Outlet boxes mounted cast into concrete shall be concrete tight, and shall be made of galvanized steel or PVC.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Pull and Junction Boxes

1. Pull boxes and junction boxes shall be solidly attached to structural members prior to installation of conduit and set true and plumb. Boxes shall not be supported by their associated conduits.

2. Wooden plugs are not permitted for securing boxes to concrete. Appropriately rated anchors specifically suited for use in concrete shall be used.

3. Box penetrations for conduits shall be made with a punch tool, and penetrations shall be of the size required for the conduit entry and/or hub. Oversized penetrations in boxes are not acceptable.

4. Watertight conduit hubs shall be provided for boxes where a NEMA 4X enclosure rating is specified. Refer to Section 16111, Conduit, for conduit hub requirements.

5. Pull and junction boxes may be installed flush mounted in gypsum, concrete or CMU walls where appropriate provided that covers are easily removed or opened.

6. Pull and junction boxes shall be provided in the enclosure type and material of construction required for the area in which it is installed. Reference the requirements in Part 2 herein, and the area designations indicated on the Drawings.

B. Outlet Boxes

1. Outlet boxes shall be solidly attached to structural members prior to installation of conduit and set true and plumb. Boxes shall not be supported by their associated conduits.

2. Wooden plugs are not permitted for securing boxes to concrete. Appropriately rated anchors specifically suited for use in concrete shall be used.

3. Flush mounted outlet boxes shall be arranged and located so that tile and grout lines fit closely around the boxes, and so placed that the cover or device plate shall fit flush to the finished wall surface.

4. Outlet boxes shall be flush mounted in finished areas and other areas where practical. Flush mounted outlet boxes shall not be installed in hazardous areas and type 1 or 2 chemical storage/transfer areas.

5. For the below-named items, mounting heights from finished floor, or finished grade to top is applicable, depending on the type of wiring device to be installed in the outlet box. Mounting heights for outlet boxes shall be as follows, unless otherwise specified herein, indicated on the Drawings, or required by the Americans with Disability Act (ADA):

    a. Light switches and wall mounted occupancy sensors, 48 inches

    b. Receptacles in indoor dry process/non-process areas, 16 inches

    c. Receptacles in indoor wet process areas and all indoor chemical storage/transfer areas, 48 inches

    d. Receptacles in outdoor locations, 24 inches

    e. Ceiling mounted occupancy sensors, as indicated on the Drawings

6. Outlet boxes shall be provided in the material of construction required for the area in which it is installed. Reference the requirements in Part 2 herein, and the area designations indicated on the Drawings.

- END OF SECTION -

SECTION 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 Public Utilities 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 Public Utilities 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 Public Utilities 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 Public Utilities 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 Public Utilities 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 supports for mounting and installing all conduit, electrical equipment, 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 Public Utilities General Conditions and Section 01300, Submittals, the CONTRACTOR shall obtain from the equipment manufacturer and submit the following:

1. Shop drawings

2. Structural support calculations (if required)

B. 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. Support channel shall be 1-5/8” by 1-5/8” minimum, with 12 gage material thickness.

B. Support channel, support channel fittings, and threaded rod shall be furnished with the following material of construction, dependent upon the designation of the area in which they are to be installed. Area designations are indicated on the Drawings.

AREA DESIGNATION	**MATERIAL OF CONSTRUCTION**
Indoor Wet Process Area	Type 3016Stainless Steel
Indoor Dry Process Area	Hot Dipped Galvanized Steel
Indoor Dry Non-process Area	Hot Dipped Galvanized Steel
Type 1 Chemical Storage/Transfer Area	Fiberglass
Type 2 Chemical Storage/Transfer Area	Type 316 Stainless Steel
All Outdoor Areas	Type 316 Stainless Steel
All Hazardous Areas	Type 316 Stainless Steel

C. Fastening hardware (bolts, nuts, washers, and screws) shall be furnished with the following material of construction, dependent upon the designation of the area in which they are to be installed. Area designations are indicated on the Drawings.

AREA DESIGNATION	**MATERIAL OF CONSTRUCTION**
Indoor Wet Process Area	Type 316 Stainless Steel
Indoor Dry Process Area	Type 316 Stainless Steel
Indoor Dry Non-process Area	Type 316 Stainless Steel
Type 1 Chemical Storage/Transfer Area	Fiberglass
Type 2 Chemical Storage/Transfer Area	Type 316 Stainless Steel
All Outdoor Areas	Type 316 Stainless Steel
All Hazardous Areas	Type 316 Stainless Steel

PART 3 – EXECUTION

3.01 INSTALLATION

A. Concrete or Masonry Inserts

1. The CONTRACTOR shall be responsible for the furnishing and installation of all 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 channels for all switchgear, switchboards, motor control centers, and similar floor mounted equipment. The leveling channels shall be provided for embedment in the equipment housekeeping pads. Coordination of the installation of these channels with the concrete pad is essential and required. Pad height shall be as required to maintain concrete coverage of the reinforcement bars while not causing associated equipment to exceed the maximum mounting height requirements of the NEC.

B. Support Fastening and Locations

1. All equipment fastenings to columns, steel beams, and trusses shall be by beam clamps or welded. No holes shall be drilled in the steel.

2. All holes made in reflected ceilings for support rods, conduits, and other equipment shall be made adjacent to ceiling grid bars where possible, to facilitate removal of ceiling panels.

3. Support channel shall be provided wherever required for the support of starters, switches, panels, and miscellaneous equipment.

4. All equipment, devices, and raceways that are installed on the dry side of a water bearing wall shall not be installed directly onto the wall. Support channel shall be used to allow ventilation air to pass behind the equipment, devices, or raceway.

5. 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.

6. 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.

7. Actual designs for supporting framework should take the nature of a picture frame of support channels and bracket with a plate for mounting the components. The CONTRACTOR is responsible for the design of supporting structure; he shall submit design details to the ENGINEER for acceptance before proceeding with the fabrication.

8. Wherever dissimilar metals come into contact, the CONTRACTOR shall isolate these metals as required with neoprene washers, nine (9) mil polyethylene tape, or gaskets.

9. For all installations where fiberglass supporting materials are required, the CONTRACTOR shall submit structural calculations and the details of the proposed system of support. Structural calculations shall be signed and sealed by a registered Professional Engineer in the State of Florida.

10. For the following installations where conduits are provided with a support system suspended from the above or attached to a vertical structure, the CONTRACTOR shall submit structural calculations and details of the proposed system of support. Structural calculations shall be signed and sealed by a registered Professional Engineer in the State of Florida.

    a. A quantity of twelve (12) or more conduits trade size 1" and smaller are proposed for a conduit support rack.

    b. A quantity of eight (8) or more conduits trade sizes 1 ½" to 2 1/2" are proposed for a conduit support rack.

    c. A quantity of four (4) or more conduits trade sizes 3" and larger are proposed for a conduit support rack.

- 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 and 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 Public Utilities 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, white with black lettering.

B. Nameplates shall be attached to NEMA 4X enclosures utilizing UL-recognized mounting kits designed to maintain the overall UL Type rating of the enclosure. Mounting kit fasteners shall be stainless steel Type AHK10324X as manufactured by Hoffman, or equal.

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, Low Voltage Wire and Cable.

B. A plastic laminate nameplate shall be provided at each panelboard, motor control center, switchgear assembly, and switchboard assembly. This nameplate shall be used to clearly convey the conductor identification means used at that piece of equipment (i.e. Phase A=Brown, Phase B=Orange, C = Yellow).

C. Wiring identification for factory installed wiring in equipment enclosures shall be as specified in the respective section.

2.06 BOX IDENTIFICATION

A. Pull, junction and device box identification shall be as specified in Section 16130 – Boxes.

PART 3 – EXECUTION

3.01 NAMEPLATES

A. Nameplates shall be attached to the equipment enclosures with (2) two stainless steel sheet metal screws for nameplates up to 2-inches wide. For nameplates over 2-inches wide, four (4) stainless steel sheet metal screws shall be used, one (1) in each corner of the nameplate. The utilization of adhesives is not permitted.

3.02 OPERATIONAL IDENTIFICATION AND WARNINGS

A. Wherever reasonably required to ensure safe and efficient operation and maintenance of the electrical systems and electrically connected mechanical systems and general systems and equipment, including prevention of misuse of electrical facilities by unauthorized personnel, install plastic signs or similar equivalent identification, instruction, or warnings on switches, outlets, and other controls, devices, and covers or electrical enclosures. Where detailed instructions or explanations are needed, provide plasticized tags with clearly written messages adequate for the intended purposes. Signs shall be attached as specified above for nameplates.

3.03 POWER SOURCE IDENTIFICATION

A. After installation of all field equipment (i.e. valves, motors, fans, unit heaters, instruments, etc) install nameplates at each power termination for the field equipment. Nameplate data shall include equipment designation (tag number), power source (MCC number, panelboard, etc), circuit number, conduit number from schedule and voltage/phase.

B. CONTRACTOR to coordinate with the ENGINEER and the 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 Public Utilities 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 Public Utilities 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 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. International Electrotechnical Commission (IEC) standards are not acceptable.

C. Reference Section 16000, Basic Electrical Requirements and Section 16195, Electrical – Identification.

1.02 CODES AND STANDARDS

A. Products specified herein shall be in conformance with or listed to the following standards as applicable:

1. NEMA 250 – Enclosures for Electrical Equipment

2. UL 508A – Standard for Industrial Control Panels

3. UL-1203 – Standard for Explosion-proof and Dust-ignition-proof Electrical Equipment for use in Hazardous (Classified) Locations.

4. ANSI/ISA 12.12.01-2013 – Nonincendive Electrical Equipment for use in Class I and II, Division II Hazardous (Classified) locations.

1.03 SUBMITTALS

A. In accordance with the procedures and requirements set forth in the Public Utilities 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.

D. The shop drawing information shall be complete and organized in such a way that the ENGINEER can determine if the requirements of these Specifications are being met. Copies of technical bulletins, technical data sheets from "soft-cover" catalogs, and similar information which is "highlighted" or somehow identifies the specific equipment items the CONTRACTOR intends to provide are acceptable and shall be submitted.

1.05 SPARE PARTS

A. All spare parts as recommended by the equipment manufacturer shall be furnished to the CITY by the CONTRACTOR. In addition to the manufacturer recommended spare parts, the following spare parts shall be provided for the local control stations:

1. One (1) contact block of each type furnished on the project per Clarifier

2. One (1) indicating light lens of each color furnished on the project

3. One (1) LED lamp of each color furnished on the project

B. 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. Manufacturers

1. Control components shall be manufactured by Eaton, The Square D Company, General Electric, Allen-Bradley, Siemens Energy and Automation, or ENGINEER approved equal.

B. Pilot Devices

1. General

a. All pilot devices shall be provided with a legend plate. Legend plates shall have a white background and black lettering and indicate the function of the respective pilot device. The text shown on the Drawings or indicated in the specifications shall be used as the basis for legend plate engraving (i.e. HAND-OFF-AUTO, RUN, EMERGENCY STOP, etc).

b. All pilot devices shall be selected and properly installed to maintain the NEMA 250 rating of the enclosure in which they are installed. All pilot devices shall be UL 508 Listed.

c. All pilot devices shall be 30.5mm in diameter, unless otherwise indicated. 22mm devices are not acceptable.

d. Pilot devices for all electrical equipment under this Contract shall be of the same type and manufacturer unless otherwise specified herein or indicated on the Drawings.

e. In Class 1 Division 2 hazardous locations, pilot devices shall be the hermetically-sealed type, constructed in accordance with ANSI/ISA 12.12.01.

2. Pushbuttons

a. Pushbuttons shall be non-illuminated, black in color, and have momentary style operation unless otherwise indicated on the Drawings.

b. Pushbuttons shall have the quantity of normally closed and/or normally open contacts as indicated on the Drawings and as required. In addition to the required contacts, one (1) spare normally open and one (1) spare normally closed contact shall be installed at each pushbutton. Contacts shall be rated for 5A at 250VAC/DC (minimum), but no less than required for the application.

c. Pushbuttons shall be provided with a full guard around the perimeter of the button. Where a lockout style pushbutton is specified or indicated on the Drawings, provide a padlockable guard.

3. Selector Switches

a. Selector switches shall be non-illuminated, black in color, and have the number of maintained positions as indicated on the Drawings and as required. Handles shall be the extended type that provide a greater surface area for operation.

b. Selector switches shall have the quantity of normally closed and/or normally open contacts as indicated on the Drawings and as required. In addition to the required contacts, one (1) spare normally open and one (1) spare normally closed contact shall be installed at each selector switch. Contacts shall be rated for 5A at 250VAC/DC (minimum), but no less than required for the application.

c. Where indicated in the Drawings or Specifications, provide spring return positions.

d. Selector switches shall be provided with an indexing component that fits into the keyed portion of the cutout for the device and prevents the switch from spinning when operated.

4. Indicating Lights

a. Indicating lights shall LED type, with the proper voltage rating to suit the application, and push-to-test feature.

b. Indicating light lens colors shall be as required in equipment specifications and/or as indicated on the Drawings. If lens colors are not indicated, the following colors shall be used:

Red - "Run", "On", “Open”
Green - "Off", “Closed”
Amber - "Alarm", "Fail"
White - “Control Power On”

5. Emergency Stop and Tagline Switches

a. Emergency stop switches shall be non-illuminated, red in color, with a minimum 35mm diameter mushroom head. Once activated, switch shall maintain its position and require a manual pull to release/reset.

b. Tagline switches shall have a plunger that activates upon tension from the associated safety cable. Once activated, switch shall maintain its position and require a manual release/reset.

c. Emergency stop and tagline switches shall have the quantity of normally closed and/or normally open contacts as indicated on the Drawings and as required. In addition to the required contacts, one (1) spare normally open and one (1) spare normally closed contact shall be installed at each switch. Contacts shall be rated for 5A at 250VAC/DC (minimum), but no less than required for the application.

B. Relays and Timers

1. General

a. Relays and timers shall be furnished with an integral pilot light for positive indication of coil energization.

b. Relays and timers shall have tubular pin style terminals with matching 11-pin DIN rail mount socket. Spade or blade style terminals are not acceptable.

c. Relays and timers for all electrical equipment under this Contract shall be of the same type and manufacturer unless otherwise specified herein or indicated on the Drawings.

2. Control and Pilot Relays

a. Miniature or “ice-cube” type relays are not acceptable.

b. Relays shall have coil voltage as required to suit the application and/or as indicated on the Drawings.

c. Relays shall be provided with contacts rated for 10A (resistive), minimum, at 120/240 VAC and 28 VDC. Relays shall have 3-pole, double-throw (3PDT) contact arrangement.

3. Time Delay Relays

a. Timers delay relays shall utilize electronic timing technology. Mechanical timing devices are not acceptable.

b. Relays shall have coil voltage as required to suit the application and/or as indicated on the Drawings.

c. Relays shall be provided with contacts rated for 10A (resistive), minimum, at 120/240 VAC and 28 VDC. Relays shall have double-pole double-throw (DPDT) contact arrangement.

d. Time delay ranges shall be as indicated on the Drawings and/or as required to suit the application. Timing range shall be adjustable from the front of the relay. On delay and off delay timer configurations shall be provided as indicated on the Drawings and/or as required to suit the application.

4. Elapsed Time Meters

a. Elapsed time meters shall be non-resettable type with no less than a 4 digit display. Coil voltage shall be as required to suit the application and/or as indicated on the Drawings.

D. Control Terminal Blocks

1. Control terminal blocks shall be assembled on non-current carrying galvanized steel DIN mounting rails securely bolted to the enclosure or subpanel. Terminals shall be tubular screw type with pressure plate that will accommodate wire size range of #22 - #8 AWG.

2. Control terminal blocks shall be single tier with a minimum rating of 600 volts and 20A. Separate terminal strips shall be provided for each type of control used (i.e. 120VAC vs. 24VDC). Quantity of terminals shall be provided as required to suit the application. In addition, there shall be a sufficient quantity of terminals for the termination of all spare conductors.

3. Terminals shall be marked with a permanent, continuous marking strip, with each terminal numbered. One side of each terminal shall be reserved exclusively for incoming field conductors. Common connections and jumpers required for internal wiring shall not be made on the field side of the terminal.

2.02 LOCAL CONTROL STATIONS

A. Local control stations shall be furnished and installed complete with pushbuttons, selector switches, indicating lights, and other devices as indicated on the Drawings.

B. Specific devices installed in local control stations shall be provided in accordance with the requirements specified elsewhere in this Section.

C. In non-hazardous locations, local control stations shall be furnished with the following enclosure type and material of construction, dependent upon the designation of the area in which they are to be installed. Area designations are indicated on the Drawings.

AREA DESIGNATION	**ENCLOSURE TYPE AND MATERIAL**
Indoor Wet Process Area	NEMA 4X, Type 316 Stainless Steel
Indoor Dry Process Area	NEMA 12, Die Cast Zinc
Indoor Dry Non-process Area	NEMA 12, Die Cast Zinc
Indoor Type 1 Chemical Storage/Transfer Area	NEMA 4X, Fiberglass or Thermoplastic Polyester
Indoor Type 2 Chemical Storage/Transfer Area	NEMA 4X, Type 316 Stainless Steel
All Outdoor Areas	NEMA 4X, Type 316 Stainless Steel

D. In hazardous locations, local control stations shall be furnished with the following enclosure type and material of construction, dependent upon the classification of the area in which they are to be installed. Area classifications are indicated on the Drawings.

AREA CLASSIFICATION	**ENCLOSURE TYPE AND MATERIAL**
Class 1, Division 1, Group D	NEMA 7, Die Cast Aluminum
Class 1, Division 2, Group D	NEMA 4X, Type 316 Stainless Steel
Class 2, Division 1, Group F	NEMA 9, Die Cast Aluminum
Class 2, Division 2, Group F	NEMA 9, Die Cast Aluminum

E. Non-metallic enclosures, NEMA 7 enclosures, and NEMA 9 enclosures shall be provided with threaded integral conduit hubs. Conduit hubs shall be external to the enclosure.

F. Local control stations for use in non-hazardous locations shall be UL-508 Listed. Local control stations for use in Class 1 Division 1 and Class 2 Divisions 1/2 hazardous locations shall be UL-1203 Listed. Local control stations for use in Class 1 Division 2 hazardous locations shall be in accordance with ANSI/ISA 12.12.01-2013.

G. Provide a nameplate on each local control station in accordance with Section 16195, Electrical – Identification. The name and/or number of the equipment associated with each control station shall be engraved on the nameplate, followed by the words “LOCAL CONTROL STATION”.

2.03 ELECTRONIC SHOCK RELAY

A. Electronic shock relays shall be furnished and installed complete with enclosures, as indicated on the Drawings. Electronic shock relay shall provide supplemental protection for clarifier drive mechanisms against over-torque conditions. Relay enclosure shall be furnished with viewing window to allow operator to view relay current meter and settings.

B. Electronic shock relays shall be suitable for monitoring AC induction motor circuits.

C. Electronic shock relays shall be suitable for operation on 120VAC, 60 Hz control power supply.

D. Furnish with the following features and functions:

1. Load current meter: Instantaneous motor current shall be displayed to facilitate load current setting adjustments.

2. Load current setting: Shall allow the operator to adjust the load current set point. When load current exceeds the set point for a period in excess of the shock time setting, the relay shall trip. Load current setting range shall be 30% to 130% of motor current.

3. Shock time setting: Shall allow the operator to adjust the time delay for load currents in excess of the load current set point, after which, the relay shall trip. Shock time range shall be from 0.2 to 3 seconds.

4. Impact setpoint: Shall allow the operator to set a motor current set point, which when exceeded for 5/100ths of a second, shall cause the relay to trip.

5. Start time setting: Shall allow the operator to set a time delay during which load currents in excess of the setpoint are allowed, as required for motor starting.

6. Manual test feature: Shall allow the operator to verify proper operation of the relay.

7. Manual reset: Manual reset shall be required after the relay has tripped.

8. Relay shall provide visual indication when control power is available, and when relay has tripped.

E. Furnish with Form C relay contacts rated 0.2A minimum at 250VAC.

F. Shock relay shall be Tsubaki TSB151M or equal.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Local control stations shall be provided in the enclosure type and material of construction required for the area in which it is installed. Reference the requirements in Part 2 herein, and the area designations indicated on the Drawings.

B. 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.

C. Pilot devices shall be properly bonded to the equipment enclosure door where they are installed. If proper bonding cannot be achieved through the locknuts that affix the device in place, a green colored bonding screw shall be provided on the pilot device. The bonding screw shall be bonded to the equipment enclosure through the use of an insulated green bonding conductor.

D. Local control station covers shall be bonded to the local control station enclosure through the use of an insulated green bonding conductor.

E. Wiring to devices at each local control station shall be provided with enough slack to permit the local control station cover to be removed and pulled at least 6 inches away from the enclosure.

F. Terminal strips, relays, timers, and similar devices shall not be installed on the rear of the panel/cabinet doors. Terminal strips, relays, timers, and similar devices shall not be installed on the side walls of panel/cabinet interiors without written permission from the ENGINEER.

G. CONTRACTOR shall coordinate shock relay settings with clarifier dynamic testing, per this section. Closely monitor shock relay load current during dynamic testing as required for determining load current settings. Note maximum current load achieved during test. Adjust start time, impact, and shock time settings as required to adequately protect the clarifier drive mechanism in the event that the clarifier drive mechanism torque switch fails. Adjust these settings as required to avoid nuisance tripping. Shock time setting shall be adjusted as required to allow the torque switch to trip before the shock relay trips during an over-torque condition.

- 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, components, system installation services, as well as required and specified ancillary services in connection with the Instrumentation, Control and Information System.

B. The System includes materials, labor, tools, fees, charges, and documentation required to furnish, install, test and place in operation a complete and operable instrumentation, control and information system.

C. The system shall include measuring elements, signal converters, transmitters, local control panels, digital hardware and software, operator workstations, SCADA HMI and historian servers, signal and data transmission systems, interconnecting wiring, and pertinent accessories.

D. The scope of the work to be performed under this Division includes but is not limited to the following:

1. The CONTRACTOR shall retain overall responsibility for the instrumentation and control system as specified herein.

2. Furnish and install process instrumentation and associated taps and supports as scheduled or shown on the Drawings, unless otherwise noted or supplied by equipment vendors.

3. Furnish and install local control panels, field panels and associated cabinets and panels as shown on the Drawings and as specified in this Division, unless otherwise noted or supplied by equipment vendors.

4. Furnish and install digital control system hardware and software as specified in this Division, inclusive and where included.

5. Final termination and testing of instrumentation and control system signal wiring and power supply wiring at equipment furnished under this Division, inclusive and where included.

6. Furnish, install and terminate special cables for devices (e.g., instruments, printers, radios). Furnish and terminate control system communication network cables.

7. Furnish and install surge protection devices for digital equipment, local control panels, remote telemetry units, and instrumentation provided under this Division, including connections to grounding system(s) provided under Division 16.

8. Coordinate grounding requirements with the electrical subcontractor for digital equipment, local control panels, remote telemetry units, and instrumentation provided under this Division. Terminate grounding system cables at equipment provided under this Division.

9. Provide system testing, calibration, training and startup services as specified herein and as required to make systems fully operational.

E. It is the intent of the Contract Documents to construct a complete and working installation. Items of equipment or materials that may reasonably be assumed as necessary to accomplish this end shall be supplied whether or not they are specifically stated herein.

1.02 RELATED ITEMS

A. Field mounted switches, torque switches, limit switches, gauges, valve and gate operator position transmitters, sump pump controls, and other instrumentation and controls furnished with mechanical or electrical equipment not listed in the instrument schedule shall be furnished, installed, tested, and calibrated as specified under other Divisions unless otherwise indicated.

B. Additional and related work performed under Division 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 equipment, control panels and accessories furnished under this Division, inclusive and where included.

2. Conduit and raceways for instrumentation and control system signal wiring, grounding systems, special cables and communication network cables.

3. Instrumentation and control system signal wiring.

4. Install control system communication network cables.

5. Furnish and install grounding systems for digital equipment, local control panels, remote telemetry units, and instrumentation provided this Division, inclusive and where included. Grounding systems shall be complete to the equipment provided

under this Division, inclusive, and where included, ready for termination by the instrumentation subcontractor.

6. Termination of instrumentation and control system signal wiring at equipment furnished under other Divisions of the Specifications.

7. Final wiring and termination to A.C. grounding systems and to A.C. power sources (e.g., panelboards, motor control centers, and other sources of electrical power).

1.03 GENERAL INFORMATION AND DESCRIPTION

A. Where manufacturers are named for a particular item of equipment, it is intended as a guide to acceptable quality and performance and does not exempt such equipment from the requirements of these Specifications or Drawings.

B. In order to centralize responsibility, it is required that equipment (including field instrumentation and control system hardware and software) offered under this Division shall be furnished and installed by the instrumentation subcontractor, or under the supervision of the instrumentation subcontractor, who shall assume complete responsibility for proper operation of the instrumentation and control system equipment, including that of coordinating signals, and furnishing appurtenant equipment.

C. The CONTRACTOR shall retain total responsibility for the proper detailed design, fabrication, inspection, test, delivery, assembly, installation, activation, checkout, adjustment and operation of the entire instrumentation and control system as well as equipment and controls furnished under other Divisions of the Specifications. The CONTRACTOR shall be responsible for the delivery of detailed drawings, manuals and other documentation required for the complete coordination, installation, activation and operation of mechanical equipment, equipment control panels, local control panels, field instrumentation, control systems and related equipment/systems and shall provide for the services of a qualified installation engineer to supervise activities required to place the completed facility in stable operation under full digital control.

D. The instrumentation and control system shall be capable of simultaneously implementing all real time control and information system functions, and servicing all operator service requests as specified, without degrading the data handling and processing capability of other system components.

E. Control system inputs and outputs are listed in Section 17920 – Control System 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 equipment, panels, instrumentation, controls, and appurtenances, either existing or furnished on the Project to determine requirements for interfacing with the control and information system. The CONTRACTOR shall coordinate the completion of required modifications with the associated supplier of the item furnished.

G. The instrumentation subcontractor shall review and approve the size and routing of instrumentation and control cable and conduit systems furnished by the electrical subcontractor for suitability for use with the associated cable system.

H. The CONTRACTOR shall coordinate the efforts of each supplier to aid in interfacing systems. This effort shall include, but shall not be limited to, the distribution of approved shop drawings to the electrical subcontractor and to the instrumentation subcontractor furnishing the equipment under this Division.

I. The CONTRACTOR shall be responsible for providing a signal transmission system free from electrical interference that would be detrimental to the proper functioning of the instrumentation and control system equipment.

J. The CITY shall have the right of access to the subcontractor's facility and the facilities of his equipment suppliers to observe materials and parts; witness inspections, tests and work in progress; and examine applicable design documents, records, and certifications during all stages of design, fabrication, and tests. The instrumentation subcontractor and his equipment suppliers shall furnish office space, supplies, and services required for these observation activities.

K. The terms "Instrumentation," "Instrumentation and Control System," and "Instrumentation, Control and Information System" shall hereinafter be defined as equipment, labor, services, and documents necessary to meet the intent of the Specifications.

1.04 INSTRUMENTATION AND CONTROL SYSTEM SUBCONTRACTORS

A. Acceptable instrumentation and control system subcontractors shall be one of the following; no substitutions or exceptions:

1. **C.C. Controls** – Location: West Palm Beach, Florida Phone: (561) 293-3975

2. **Revere Control Systems** – Location: Lakeland, Florida Phone: (863) 646-5781

1.05 DEFINITIONS

A. Solid State: Wherever the term solid state is used to describe circuitry or components in the Specifications, it is intended that the circuitry or components shall be of the type that convey electrons by means of solid materials such as crystals or that work on magnetic principles such as ferrite cores. Vacuum tubes, gas tubes, slide wires, mechanical relays, stepping motors or other devices will not be considered as satisfying the requirements for solid state components of circuitry.

B. Bit or Data Bit: Whenever the terms bit or data bit are used in the Specification, it is intended that one bit shall be equivalent to one binary digit of information. In specifying data transmission rate, the bit rate or data bit rate shall be the number of binary digits transmitted per second and shall not necessarily be equal to either the maximum pulse rate or average pulse rate.

C. Integrated Circuit: Integrated circuit shall mean the physical realization of a number of circuit elements inseparably associated on or within a continuous body to perform the function of a circuit.

D. Mean Time Between Failures (MTBF): The MTBF shall be calculated by taking the number of system operating hours logged during an arbitrary period of not less than six months and dividing by the number of failures experienced during this period plus one.

E. Mean Time to Repair (MTTR): The MTTR shall be calculated by taking the total system down time for repair over an arbitrary period of not less than six months coinciding with that used for calculation of MTBF and dividing by the number of failures causing down time during the period.

F. Availability: The availability of a non-redundant device or system shall be related to its MTBF and MTTR by the following formula:

$$A = 100 \times (MTBF / (MTBF + MTTR)) \text{ Percent}$$

The availability of a device or system provided with an automatically switched backup device or system shall be determined by the following formula:

$$A = A2 + 1 - ((1 - A1) * (1 - A1))$$

where:

A1 = availability of non-redundant device or system

A2 = availability of device or system provided with an automatically switched backup device or system

G. Abbreviations: Specification abbreviations include the following:

1. A - Availability
2. ADC - Analog to Digital Converter
3. AI - Analog Input
4. AO - Analog Output
5. AVAIL - Available
6. BCD - Binary Coded Decimal
7. CSMA/CD - Carrier Sense Multiple Access/Collision Detect
8. CPU - Central Processing Unit
9. CRC - Cyclic Redundancy Check
10. CS - Control Strategy
11. DAC - Digital to Analog Converter
12. DBMS - Data Base Management System
13. DI - Discrete Input
14. DMA - Direct Memory Access
15. DO - Discrete Output
16. DPDT - Double Pole, Double Throw
17. DVE - Digital to Video Electronics
18. EPROM - Erasable, Programmable Read Only Memory
19. FDM - Frequency Division Multiplexing
20. FSK - Frequency Shift Keyed
21. HMI - Human Machine Interface (Software)
22. I/O - Input/Output
23. LAN - Network and Communication Equipment
24. LCD - Liquid Crystal Display

25. LDFW - Lead Follow
26. MCC - Motor Control Center
27. MTBF - Mean Time Between Failures
28. MTTR - Mean Time to Repair
29. OS - Operating System
30. PAC - Programmable Automation Controller
31. PCB - Printed Circuit Board
32. PID - Proportional Integral and Derivative Control
33. PLC - Programmable Logic Controller or Programmable Controller
34. PROM - Programmable Read Only Memory
35. RAM - Random Access Memory
36. RDY - Ready
37. RMSS - Root Mean Square Summation
38. RNG - Running
39. ROM - Read Only Memory
40. RTU - Remote Telemetry Unit
41. SPDT - Single Pole, Double Throw
42. ST/SP - Start/Stop
43. TDM - Time Division Multiplexing
44. UPS - Uninterruptible Power Supply
45. VFD - Variable Frequency Drive

H. To minimize the number of characters in words used in textual descriptions on displays, printouts and nameplates, abbreviations may be used subject to the ENGINEER's approval. If a specified abbreviation does not exist for a particular word, an abbreviation may be generated using the principles of masking and or vowel deletion. Masking

involves retaining the first and last letters in a word and deleting one or more characters (usually vowels) from the interior of the word.

1.06 ENVIRONMENTAL CONDITIONS

A. Instrumentation equipment and enclosures shall be suitable for ambient conditions specified. All system elements shall operate properly in the presence of telephone lines, power lines, and electrical equipment.

B. Inside control rooms and climate-controlled electrical rooms, the temperature will normally be 20 to 25 degrees C; relative humidity 40 to 80 percent without condensation and the air will be essentially free of corrosive contaminants and moisture. Appropriate air filtering shall be provided to meet environmental conditions (e.g., dust).

C. Other indoor areas may not be air conditioned/heated; temperatures may range between 0 and 40 degrees C with relative humidity between 40 and 95 percent.

D. Field equipment including instrumentation and panels may be subjected to wind, rain, lightning, and corrosives in the environment, with ambient temperatures from -20 to 40 degrees C and relative humidity from 10 to 100 percent. All supports, brackets, interconnecting hardware, and fasteners shall be aluminum, type 316 stainless steel, or metal alloy as otherwise suitable for chemical resistance within chemical feed/storage areas shown on the installation detail drawings.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.01 SCHEDULE OF PAYMENT

A. Payment to the CONTRACTOR for Control and Information System materials, equipment, and labor shall be in accordance with the Public Utilities General Conditions and Supplementary General Conditions. The schedule of values submitted as required by the Public Utilities General Conditions and Supplementary General Conditions shall reflect a breakdown of the work required for completion of the Control and Information System. The breakdown shall include sufficient detail to permit the ENGINEER to administer payment for the Control and Information System.

B. The following payment schedule defines project milestones that will be used for establishing maximum partial payment amounts for the Control and Information System. Payment for field instruments, field wiring, fiber optic network cable and similar items will be made in addition to the payment for the scopes of services incorporated into the schedule below.

1. Task Completed - Maximum Cumulative % Request for Payment

    a. Mobilization - 10%

    b. Approved Submittals - 30%

    c. Hardware Purchase (excludes field instruments) - 50%

    d. Loop Checkout - 70%

    e. Control System Start-up and Test - 80%

    f. Plant Start-up - 90%

    g. Final System Acceptance Test - 95%

    h. Final Acceptance - 100%

C. Requests for payment for materials and equipment that are not installed on site, but are required for system construction and the factory witness test (e.g., digital hardware), or are properly stored as described in the Public Utilities General Conditions and Supplementary General Conditions and herein, shall be accompanied by invoices from the original supplier to the instrumentation subcontractor substantiating the cost of the materials or equipment.

D. Any balance remaining within the schedule of values for field instruments and other materials installed on the site, or for other materials for which payment is made by invoice, will be considered due upon completion of the Final Acceptance test.

3.02 CLEANING

A. The CONTRACTOR shall thoroughly clean soiled surfaces of installed equipment and materials.

B. Upon completion of the instrumentation and control work, the CONTRACTOR shall remove surplus materials, rubbish, and debris that has accumulated during the construction work. The entire area shall be left neat, clean, and acceptable to the 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 control system training requirements.

4. Completion of punch-list items that are significant in the opinion of the ENGINEER.

B. Final acceptance of the System shall mark the beginning of the warranty period.

- END OF SECTION -

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 Public Utilities General Conditions, Supplementary General Conditions and Division 01 of the Specifications. All submittal material shall be complete, legible, and reproducible, and shall apply specifically to this project.

B. All submittal materials shall be tailored to this project by highlighting relevant items or crossing out non-applicable items. Generic submittals without identified options will be returned the CONTRACTOR without review.

C. Compliance, Deviations, and Exceptions (CD&E) Letter:

1. Where a named manufacturer and product is specified and a substitution or an “or equal” product is submitted, the submittal shall be accompanied by a “Compliance, Deviations, and Exceptions (CD&E) letter.” If the required submittal is submitted without the letter, the submittal will be rejected.

2. The letter shall include all comments, deviations and exceptions taken to the Drawings and Specifications by the CONTRACTOR, subcontractor (if applicable), and the equipment Manufacturer/Supplier. This letter shall include a copy of the Specification Section to which the submittal pertains. In the left margin beside each and every paragraph/item, a letter "C", "D", or "E" shall be typed or written in.

    a. The letter "C" shall be for full compliance with the requirement.

    b. The letter "D" shall be for a deviation from the requirement.

    c. The letter "E" shall be for taking exception to a requirement.

3. Any requirements with the letter "D" or "E" beside them shall be provided with a full typewritten explanation of the deviation/exception. Handwritten explanation of the deviations/exceptions shall not be acceptable.

4. The CD&E letter shall also address deviations, and exceptions taken to each Drawing related to this Specification Section.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01300 – Submittals

B. Section 17000 – Control and Information System Scope and General Requirements

1.03 EXISTING CONDITIONS / AS-BUILT DOCUMENTATION SUBMITTAL

A. Prior to modifying, demolishing, removing, or decommissioning equipment, thoroughly investigate and document the existing conditions. Please note that CITY's record drawings alone are not sufficient for documentation. The record drawings, if present, shall be verified in the field prior to submitting. Submit drawings, markup, sketches, information, or other materials for documenting the following existing conditions:

1. All I/O on PLC modules that have its wiring modified or new I/O terminated or for any PLC that is being decommissioned/removed/demolished. Document module number, point number, wire numbers, terminal numbers, destination, and function.

2. All wiring entering or leaving a PLC that is being decommissioned, removed, or demolished that is not otherwise accounted for.

B. When all information has been gathered, it shall be submitted to ENGINEER along with a clear and unequivocal statement that the existing conditions have been documented and understood. CONTRACTOR shall be held responsible for all issues that arise due to CONTRACTOR's modifications, demolition, removal, or decommissioning of existing equipment, including necessary reversion back to previous conditions.

1.04 DIGITAL HARDWARE SUBMITTALS

A. Submit system block diagram(s) showing:

1. All equipment to be provided.

2. All interconnecting cable.

3. Equipment names, manufacturer, and model numbers.

4. Equipment locations.

B. Submit information for all digital equipment including, but not limited to, the following:

1. Bill of materials with equipment names, manufacturers, complete model numbers and locations.

2. Catalog cuts, including complete part number breakdown information.

3. Complete technical, material and environmental specifications.

4. Assembly drawings.

5. Mounting requirements.

6. Color samples.

7. Nameplates.

8. Environmental requirements during storage and operation.

1.05 SOFTWARE SUBMITTALS

A. Software submittals shall include the following as a minimum:

1. Bill of materials with software names, vendors, and complete listings of included software modules.

2. Standard manufacturer's literature describing the products.

3. Description of function of software in Control and Information System.

4. Limitations or constraints of software.

5. Minimum system (processor and memory) requirements.

6. Operation and maintenance requirements.

B. Submit information on the following software:

1. Third-party software, including:

a. Operating system.

b. Operator workstation (SCADA or HMI) software, including all add-in software provided to perform specific functions (alarm dialers, schedulers, backup creation software, etc.).

c. Office-type products, such as spreadsheets, word processors, etc.

d. Database management software.

e. Communication software, including all applicable local and wide area network software.

f. Programmable controller programming software (where applicable).

2. Software configuration, including:

a. Graphic display organization.

b. Database configuration for operator workstations and database management system.

c. Trends.

d. System security.

e. Formats for all reports, including all required calculations.

f. Intercommunications between software products required to implement system functions.

g. Equipment backup configuration and requirements.

C. Control Strategies

1. Description of automatic logic and all non-standard manual logic using plain English, for non-technical persons, and written in CONTRACTOR's own words. The write-up shall include references to associated I/O, tag/loop numbers, alarming/interlocks.

2. Submitting language verbatim to Section 17950 – Functional Control Descriptions shall not be acceptable.

D. Application Software

1. Provide application software documentation that contains program descriptions for the operation, modification, and maintenance of all application programs provided for the digital system.

2. Application software includes all custom routines developed specifically for this project, or pre-written routines used for accomplishing specified functions for this project. This shall include any add-in custom software.

E. Graphic Displays

1. Submit all graphic displays required to perform the control and operator interface functions specified herein. Submitted graphic displays shall be for both new and modified graphics.

2. Submit the complete set of graphic displays for review by the CITY and the ENGINEER at least 60 days prior to commencement of factory testing.

3. Where a large number of graphic displays are required, submit an initial set of example displays for review before the complete set of displays is submitted. This initial set shall include examples of all basic graphic display design features and parameters and is intended to allow the CONTRACTOR to obtain preliminary

approval of these features and parameters prior to beginning main graphic display production.

4. The CONTRACTOR shall allow for one major cycle of revisions to the displays prior to field testing and one minor cycle of revisions following field test. A cycle of revisions shall be defined as all revisions necessary to complete a single set of changes marked by the ENGINEER and the CITY. 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.

5. The required submittals in each revision cycle shall be full color prints of the entire set of displays.

6. Displays shall be printouts of actual process graphics implemented in the system.

1.06 CONTROL PANEL SUBMITTALS

A. Submittals shall be provided for all control panels, and shall include:

1. Exterior panel drawings with front and side views, to scale.

2. Interior layout drawings showing the locations and sizes of all equipment and wiring mounted within the cabinet, to scale.

3. Panel area reserved for cable access and conduit entry.

4. Location plans showing each panel in its assigned location.

B. Submit information for all exterior and interior panel mounted equipment including, but not limited to, the following:

1. Bill of materials with equipment names, manufacturers, complete model numbers and locations.

2. Catalog cuts, including complete part number breakdown information.

3. Complete technical, material and environmental specifications.

4. Assembly drawings.

5. Mounting requirements.

6. Color samples.

7. Nameplates.

8. Environmental requirements during storage and operation.

C. Submit panel wiring diagrams showing power, signal, and control wiring, including surge protection, relays, courtesy receptacles, lighting, wire size and color coding, etc.

1.07 INSTRUMENT SUBMITTALS

A. Submit information on all field instruments, including but not limited to the following:

1. Product (item) name and tag number used herein and on the Contract Drawings.

2. Catalog cuts, including complete part number breakdown information.

3. Manufacturer's complete model number.

4. Location of the device.

5. Input output characteristics.

6. Range, size, and graduations.

7. Physical size with dimensions, NEMA enclosure classification, and mounting details.

8. Materials of construction of all enclosures, wetted parts and major components.

9. Instrument or control device sizing calculations where applicable.

10. Certified calibration data on all flow metering devices.

11. Environmental requirements during storage and operation.

12. Associated surge protection devices.

13. Installation drawings/details.

1.08 WIRING AND LOOP DIAGRAMS

A. Submit interconnection wiring and loop diagrams for all panels and signals in the Control and Information System.

B. Electrical interconnection diagrams shall show all terminations of equipment, including terminations to equipment and controls furnished under other Divisions, complete with equipment and cable designations. Where applicable, interconnection wiring diagrams shall be organized by input/output card. Interconnecting diagrams shall be prepared in a neat and legible manner on 11 X 17-inch reproducible prints.

C. Loop drawings shall conform to the latest version of ISA Standards and Recommended Practices for Instrumentation and Control. Loop Drawings shall conform to ISA S5.4,

Figures 1-3, Minimum Required Items [Figures 4-6, Minimum Required Items plus Optional Items].

D. Loop drawings shall not be required as a separate document provided that the interconnecting wiring diagrams required in Paragraph B., above, contain all information required by ISA 5.4.

1.09 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 non-programming-oriented readers.

2. A program description that shall include, but not be limited to, the following:

a. Applicable Documents - List all documents (standard manufacturer's literature, other program descriptions, etc.) by section, if practical, that apply to the program. One complete copy of all applicable reference material shall be provided.

b. Input Output - Identify each input and output parameter, variable, and software element used by the program. State the purpose of all inputs, outputs, and variables.

c. Processing - This section shall contain a description of the overall structure and function of the program. Describe the program run stream and present a detailed description of how the program operates. Describe the timing and sequencing of operations of the program relative to other programs. Describe all interactions with other programs. Processing logic that is not readily described without considerable background information shall be handled as a special topic with references to an appendix or to control strategy document that details the necessary information. Reference shall also be made to an appendix or control strategy document for equation and program algorithm derivations.

d. System Configuration - Describe in detail the system configuration or status required for program implementation, if appropriate.

e. Limitations and Constraints - Summarize all known or anticipated limitations of the program, if appropriate.

f. Storage - Define program storage requirements in terms of disk or RAM memory allocation.

g. Verification - Describe, as a minimum, a test that can be used by the operator to assure proper program operation. Define the required system configuration, input requirements and criteria for successful test completion.

h. Diagnostics - Describe all program diagnostics, where applicable. Descriptions shall list each error statement, indicate clearly what it means, and specify what appropriate actions should be taken.

i. Malfunction Procedures - Specify procedures to follow for recovering from a malfunction due to either operator error or other sources.

1.10 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. Provide a complete set of detailed electrical interconnection diagrams required to define the complete instrumentation and control system. All diagrams shall be 11 X 17-inch original reproducible prints. All diagrams shall be corrected to describe final "as built" hardware configurations and to reflect the system configuration and control methodology adopted to achieve final system acceptance.

C. Provide system software documentation for the operation and maintenance of all system software programs provided as a part of the digital system. All system software documentation shall be amended as required to delineate all modifications and to accurately reflect the final as built software configurations.

D. Provide application software documentation that contains program descriptions for the operation, modification, and maintenance of all application programs provided for the digital system.

E. Provide control strategy documentation which shall include control strategy (block oriented or ladder logic) diagrams to describe the control of all processes. Control strategy documentation shall reflect the system configuration and control methodology adopted to achieve final system acceptance. Control strategy documentation shall conform to the submittal requirements listed hereinabove.

F. O&M documentation shall be amended with all final, adjusted values for all setpoints and other operating parameters for CITY reference.

G. 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 all standard, of-the-shelf system and application software (exclusive of firmware resident software) on original media furnished by the software manufacturer.

B. Provide one copy of source listings on digital media, acceptable to ENGINEER, for all custom software/logic written specifically for this facility, all database files configured for this facility, and all control strategies. All source listings shall include a program abstract, program linkage and input/output data. Comments describing the program flow shall be frequently interspersed throughout each listing.

C. All software/logic shall be in both its native format and in Adobe Portable Document Format.

1.12 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). Raster scans will not be accepted.

1.13 ELECTRONIC O&M MANUALS

A. Subject to acceptance by the ENGINEER, the O&M information may be submitted in part or in whole in an electronic format on digital media.

B. Electronic O&M manuals shall contain information in standard formats (searchable Adobe PDF, Word, AutoCAD, HTML, etc.) and shall be easily accessible using standard, “off-the-shelf” software such as an Internet browser. Raster scans will not be accepted.

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 60 days prior to beginning training, submit a detailed training plan describing the following:

1. A listing of all courses to be conducted.

2. Course content.

3. Applicability of each course to management, operations, maintenance, laboratory, etc., personnel.

4. Course schedules.

5. Qualifications and experience of individual(s) providing training.

B. A minimum of 21 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. As used herein, the term "day" shall mean an eight-hour day, and the term "week" shall mean a five-day, 40-hour week.

C. Training courses, especially those for operator training, may be required to be scheduled during non-standard business hours (i.e., not between the hours of 8:00 am and 5:00 pm) to accommodate the working schedule of the CITY’s personnel. No additional compensation will be awarded to the CONTRACTOR for training at non-standard hours.

D. All training courses shall complement the experience and skill levels of the CITY's personnel.

E. Training courses shall be structured in order of increasing capability or security levels. The purpose of this requirement is to allow personnel with lesser training requirements or security password levels to drop out of the training at certain times while the training continues for personnel with greater requirements or higher security levels.

F. All training courses shall include lecture as well as "hands on" experience for each of the attending personnel. The CONTRACTOR shall provide sufficient equipment for this to be accomplished. For example, training in which the instructor uses the computer and the CITY's personnel passively observe as the instructor demonstrates system functions shall not be acceptable.

G. Unless otherwise specified, all training courses shall be conducted in the CITY's facilities.

H. All training shall be completed prior to system acceptance.

I. Standard manufacturer training courses are acceptable pending approval by the ENGINEER and CITY.

J. Odor Control Scrubber System to provide Scrubber System and associated chemical feed and storage systems training, including the operation of OIU-33(LCP-33). Refer to Section 13253 for training requirements.

K. Instrument Air System to provide air compressor and dryer systems training, including system monitoring functions from OIU-33(LCP-33). Refer to Section 11371 for training requirements.

1.05 SYSTEM SUPERVISOR/ENGINEER TRAINING

A. Provide training in the use and configuration of the SCADA HMI screens furnished or modified under this contract.

B. One system supervisor/engineer training, 4 hours in duration, shall be performed a minimum of 30 days prior to system startup.

C. Training shall be provided in the following subjects:

1. Overview of SCADA HMI screen additions and modifications.

2. Overview of SCADA network configuration changes.

3. Explanation of remote control and monitoring capability of Odor Control Scrubber System and Instrument Air Supply System, including system start-up and shutdown procedures.

4. Radar level transducer, LT-60011 and LT-60031, and display/transmitter, LIT-60011 and LIT-60031, Bluetooth application and diagnostics training.

5. System Alarms, including LCP-33 and LAP-60011 Horn Silence and Alarm Reset procedures.

1.06 OPERATOR/MAINTENANCE STAFF TRAINING

A. Two Operator/Maintenance Staff training sessions, 4 hours in duration each, shall performed a minimum of 30 days prior to system startup.

B. Training shall be provided in the following subjects:

1. Overview of SCADA HMI screen additions and modifications.

2. Explanation of remote control and monitoring capability of Odor Control Scrubber System and Instrument Air Supply System, including system start-up and shutdown procedures.

3. Radar level transducer, LT-60011 and LT-60031, and display/transmitter, LIT-60011 and LIT-60031, Bluetooth application and diagnostics training.

4. System Alarms, including LCP-33 and LAP-60011 Horn Silence and Alarm Reset procedures.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

- END OF SECTION -

SECTION 17050 – TOOLS, SUPPLIES, AND SPARE PARTS – GENERAL

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The CONTRACTOR shall provide tools, supplies, and spare parts as specified herein for the operation and maintenance of the Control and Information System.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01300 – Submittals

B. Section 17000 – Control and Information System Scope and General Requirements

PART 2 – PRODUCTS

2.01 TOOLS

A. Provide special tools, other than those normally found in an electronic technician's tool box, required to test, diagnose, calibrate, install, wire, connect, disconnect, assemble and disassemble any digital equipment, instrument, panel, rack, cabinet or console mounted equipment for service and maintenance. This shall include, but not be limited to, the following: connector pin insertion and removal tools, wire crimping tools, special wrenches, special instrument calibrators, indicator lamp insertion and removal tools, etc.

B. Provide tools and test equipment together with items such as instruction manuals, carrying/storage cases, unit battery charger where applicable, special tools, calibration fixtures, cord extenders, patch cords and test leads, which are not specified but are necessary for checking field operation of equipment supplied under this Division.

2.02 SUPPLIES

A. The CONTRACTOR shall provide supplies as specifically required in other Sections of Division 17.

2.03 SPARE PARTS

A. Provide spare parts for items of control and instrumentation equipment as recommended by the manufacturer and in accordance with the Contract Documents.

B. Furnish all spares in moisture-proof boxes designed to provide ample protection for their contents. Label all boxes to clearly identify contents and purpose.

C. The CONTRACTOR shall replace all spare parts consumed during installation, testing, start-up, the system availability demonstration, and the guarantee period.

D. Refer to individual digital hardware and instrument sections for additional requirements specific to those devices.

PART 3 – EXECUTION (NOT USED)

- END OF SECTION -

SECTION 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 PLCs and Control System PLCs.

D. Discrete signals shall consist of contact closures or powered signals for transmitting status/alarm information and control commands between starters, panels, equipment PLCs, the Control System, etc.

1.02 ANALOG SIGNAL TRANSMISSION

A. Signal transmission between electric or electronic instruments, controllers, and all equipment and control devices shall be individually isolated, linear 4-20 milliamperes and shall operate at 24 VDC.

B. Signal output from all transmitters and controllers shall be current regulated and shall not be affected by changes in load resistance within the unit's rating.

C. All cable shields shall be grounded at one end only, at the control panel, with terminals bonded to the panel ground bus.

D. Analog signal isolation and/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 hall be converted to an isolated, linear, 4-20 milliampere signal.

F. The CONTRACTOR shall provide 24 V power supplies for analog signals and instruments where applicable and as required inside panels, controls, etc.

G. Where two-wire instruments transmit directly to the Control and Information System, the instrumentation subcontractor shall provide power supplies at the PLC-equipped control panels for those instruments.

H. Where four-wire instruments with on-board loop power supplies transmit directly to the Control and Information System, the instrumentation subcontractor shall provide necessary signal isolators or shall otherwise isolate the input from the Control and Information System loop power supply. Similar provisions shall be made when a third element such as a recorder, indicator, or single loop controller with integral loop power supply is included in the loop.

1.03 DISCRETE INPUTS

A. All discrete inputs to equipment and Control and Information System PLCs, from field devices, starters, panels, etc., shall be unpowered (dry) contacts in the field device or equipment, powered from the PLCs, unless specified otherwise. CONTRACTOR shall notify ENGINEER of any existing field devices with discrete output signals that are powered by the field device.

B. CONTRACTOR shall verify PLC discrete input and field device output power compatibility for all field devices connected to discrete PLCs furnished under this contract and shall assume responsibility for equipment, instruments or PLC I/O modules and any other control panel devices that are damaged by the introduction of improper current or voltage to the discrete input by the CONTRACTOR or subcontractors. Replacement of damaged PLC modules or other control panel hardware with CITY’s spare parts inventory in not acceptable.

C. Sensing power (wetting voltage) supplied by the PLC shall be 24 VDC or 120 VAC and as required by the existing field devices.

1.04 DISCRETE OUTPUTS

A. All discrete outputs from local control panels and Control and Information System PLCs to field devices, starters, panels, etc., shall be either 24 VDC or 120 VAC powered (sourced) from PLC's dry contact or relay outputs.

B. 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.

C. CONTRACTOR shall verify the control signal voltage requirements of all existing devices controlled by the PLCs furnished under this contract and shall assume responsibility for equipment, instruments or PLC I/O modules and any other control panel devices that are damaged by the introduction of improper current or voltage to the discrete output circuit by the CONTRACTOR or subcontractors. Replacement of

damaged PLC modules or other control panel hardware with CITY's spare parts inventory in not acceptable.

D. Outputs to solenoid valves shall be 120 VAC, powered from the PLC or control panel unless specified or shown otherwise.

1.05 OTHER DISCRETE SIGNALS

A. Discrete signals between starters, panels, etc. where no 24 VDC power supply is available may be 120 VAC, as long as such contacts are clearly identified in the starter, panel, etc. as being powered from a different power supply than other starter/panel components.

B. Where applicable, warning signs shall be affixed inside the starter, panel, etc. stating that the panel is energized from multiple sources.

C. Output contacts in the starter, panel, etc., that are powered from other locations shall be provided with special tags and/or color-coding. Disconnecting terminal strips shall be provided for such contacts.

D. The above requirements shall apply to all starters and panels, regardless of supplier.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

- END OF SECTION -

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

D. Section 17600 – Unpowered Instruments, General

1.03 GENERAL REQUIREMENTS

A. Control system start-up and testing shall be performed to ensure that the odor control system and instrument air system are systematically and safely placed under digital control in the following order:

1. Primary elements such as transmitters and switch devices shall be calibrated and tested as specified in Section 17600 – Unpowered Instruments, General.

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 odor control and instrument air controls 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.

1.05 FINAL CONTROL ELEMENT TESTING

A. The proper control of all final control elements shall be verified by tests conducted in accordance with the requirements specified herein.

B. All modulating final control elements shall be tested for appropriate speed or position response by applying power and input demand signals, and observing the equipment for proper direction and level of reaction. Each final control element shall be tested at 0, 25, 50, 75, and 100 percent of signal input level and the results checked against specified accuracy tolerances. Final control elements, such as VFDs, that require turndown limits shall be initially set during this test.

C. All non-modulating final control elements shall be tested for appropriate position response by applying and simulating control signals, and observing the equipment for proper reaction.

1.06 LOOP CHECKOUT

A. Prior to control system startup and testing, each monitoring and control loop shall be tested on an individual basis from the primary element to the final element, including the operator workstation or loop controller level, for continuity and for proper operation and calibration.

B. Signals from transducers, sensors, and transmitters shall be utilized to verify control responses. Simulated input data signals may be used subject to prior written approval by the ENGINEER. All modes of control shall be exercised and checked for proper operation.

C. The accuracy of all DACs shall be verified by manually entering engineering unit data values at the operator workstation and then reading and recording the resulting analog output data.

D. The accuracy of all ADCs shall be verified using field inputs or by manually applying input signals at the final controller, and then reading and recording the resulting analog input data at the operator workstation.

E. Each loop tested shall be witnessed, dated and signed off by both the CONTRACTOR (or designee) and the ENGINEER upon satisfactory completion.

1.07 CONTROL SYSTEM STARTUP AND TESTING

A. Control system startup and testing shall be performed to demonstrate complete compliance with all specified functional and operational requirements. Testing activities shall include the simulation of both normal and abnormal operating conditions.

B. All digital hardware shall be fully inspected and tested for function, operation and continuity of circuits. All diagnostic programs shall be run to verify the proper operation of all digital equipment.

C. Final control elements and ancillary equipment shall be tested under start-up and steady-state operating conditions to verify that proper and stable control is achieved using local area control panels, motor control center circuits, and local field mounted control circuits. All hardwired control circuit interlocks and alarms shall be operational. The control to final control elements and ancillary equipment shall be tested using both manual and automatic (where provided) control circuits.

D. Signals from transducers, sensors, and transmitters shall be utilized to verify control responses for final control elements. Simulated input data signals may be used subject to prior written approval by the ENGINEER.

E. Each control strategy shall be tested to verify the proper operation of all required functions. The control system start-up and test activities shall include procedures for tuning all control loops incorporating PID control modules, and for adjusting and testing all control loops as required to verify specified performance.

F. The control system start-up and test activities shall include running tests to prove that the Instrumentation, Control and Information System is capable of continuously, safely and reliably regulating processes, as required by the Contract, under service conditions

that simulate, to the greatest extent possible, normal plant operating ranges and environmental conditions.

G. A witnessed functional acceptance test shall be performed to demonstrate satisfactory performance of individual monitoring and control loops and control strategies. At least one test shall be performed to verify that the control and instrumentation system is capable of simultaneously implementing all specified operations.

H. Each loop and control strategy test shall be witnessed and signed off by both the CONTRACTOR (or designee) and the ENGINEER upon satisfactory completion.

1.08 FACILITY STARTUP COORDINATION

A. Facility start-up shall comply with requirements specified in the Contract Documents and those requirements specified herein. Facility start-up shall commence after all previously described start-up and test activities have been successfully completed and shall demonstrate that the Instrumentation, Control and Information System can meet all Contract requirements with equipment operating over full operating ranges under actual operating conditions.

B. The control system start-up period shall be coordinated with process startup activities and shall be extended as required until all plant processes are fully operational and to satisfy the ENGINEER that all control system Contract requirements have been fulfilled in accordance with the Contract Documents.

C. The instrumentation subcontractor's personnel shall be resident at the facility to provide both full time (eight hours/day, five days/week) and 24 hours on call (seven days/week) support of operating and maintenance activities for the duration of the start-up period.

D. At least one qualified control systems technician shall be provided for control system startup and test activities and at least two when loop checkout is being performed.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

- END OF SECTION -

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 odor control system and instrument air 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. Process control system networks (eight hours)

e. 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 materials, equipment and workmanship in order to facilitate operations and maintenance of the facility. The CONTRACTOR shall provide equipment and services to meet this intent.

1.02 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. All Work shall be installed in accordance with the National Electric Code, National Electric Safety Code, OSHA, State/Commonwealth, local and other applicable codes.

1.03 QUALITY ASSURANCE - GENERAL

A. All equipment and materials shall be new and the products of reputable recognized suppliers having adequate experience in the manufacture of these particular items.

B. For uniformity, only one manufacturer and model will be accepted for each type of product. Where differing models are required, equipment from a single manufacturer shall be provided.

C. Equipment shall be designed for the service intended and shall be of rugged construction, of ample strength for stresses that may occur during fabrication, transportation, and erection as well as during continuous or intermittent operation. They shall be adequately stayed, braced and anchored and shall be installed in a neat and workmanlike manner. Appearance and safety, as well as utility, shall be given consideration in the design of details.

D. All components and devices installed shall be standard items of industrial grade, unless otherwise noted, which shall be of sturdy and durable construction and be suitable for long, trouble-free service.

E. Electronic components shall be de-rated to assure dependability and long-term stability.

F. Printed circuit boards in field mounted equipment shall be suitable for the specified environmental conditions.

G. Alignment and adjustments shall be non-critical, stable with temperature changes or aging and accomplished with premium grade potentiometers.

H. Components of specially selected values shall not be inserted into standard electronic assemblies in order to meet the performance requirements of this specification.

1.04 OPTIONAL EQUIPMENT

A. Optional or substituted equipment or both requiring changes in details or dimensions required to maintain structural, mechanical, electrical, control, operating, maintenance or design features incorporated in these Specifications and Drawings shall be made at no additional cost to the 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 changes with other affected trades and contracts and pay additional charges incurred.

1.05 GUARANTEE

A. The instrumentation subcontractor through the CONTRACTOR shall install, maintain and guarantee the Instrumentation, Control and Information System as specified under the Public Utilities General Conditions and Division 01 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. Preventive and corrective activities shall be documented with service reports, which shall identify the equipment being serviced, state the condition of the equipment, describe Work performed and list materials used. A copy of service reports shall be delivered to the 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 01 and, in addition, shall meet the following requirements:

1. Corrective hardware maintenance shall be performed by factory-trained service technician(s) specifically trained to service the digital equipment provided. Technicians possessing suitable training and experience shall be provided to perform corrective maintenance on other equipment. The hardware service technician(s) shall be available on-site within 24 working hours after notification by the 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 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 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.

1.06 SHIPPING HANDLING AND STORAGE

A. In addition to shipping, handling and storage requirements specified elsewhere in the Contract Documents, air conditioning/heating shall be provided for storage of field instrumentation, panels, digital equipment and ancillary devices to maintain temperatures between 20 and 25 degrees C and relative humidity 40 to 60 percent without condensation. The air shall be filtered and free of corrosive contaminants and moisture.

1.07 FABRICATION

A. Fabrication of equipment shall conform to the codes and standards outlined in this Section, and other portions of the Contract Documents.

B. The ENGINEER may inspect the fabricated equipment at the factory before shipment to job site. The CONTRACTOR shall provide the ENGINEER with sufficient prior notice so that an inspection can be arranged at the factory. Inspection of the equipment at the

factory by the ENGINEER will be made after the manufacturer has performed satisfactory checks, adjustments, tests and operations.

C. Equipment approval at the factory only allows the equipment to be shipped to the project site. The CONTRACTOR shall provide for the proper storage, installation and satisfactory start-up and operation of the equipment to the satisfaction of the equipment manufacturer, the instrumentation subcontractor, and the ENGINEER.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.01 INSTALLATION

A. Instrumentation and control system installation Work, whether new construction or modifications to existing equipment/panels/structures, shall conform to the codes and standards outlined in this Section, and other portions of the Contract Documents.

B. The instrumentation subcontractor shall assign a competent representative who shall provide full time coordination and supervision of on-site instrumentation and control system construction Work from commencement of construction through completion and final acceptance.

C. Labor shall be performed by qualified craftsmen in accordance with the standards of workmanship in their profession and shall have had a minimum of three years of documented experience on similar projects.

D. Equipment and materials shall fit properly in their installations. Work required to correct improperly fit installations shall be performed at no additional expense to the CITY.

E. Work shall be performed in a neat and workmanlike manner. Hardware and instrumentation shall be installed in accordance with requirements specified herein, in accordance with industry best practices, in accordance with manufacturers' recommendations, and in a manner suitable for ease of operation, inspection, and maintenance. Wiring shall be neatly bundled, run in wireway, and terminated. Spare wiring shall be neatly coiled and clearly labeled at both ends for future use by the CITY. 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 ensure proper operation of the plant process control system. General practices shall include:

1. Maintaining crossings between noisy wires and signal wires at right angles.

2. Maintaining separation between noisy wires and signal wires as wide as practical.

3. Grounding all signals, shields and power supplies at the process control unit or local control panel.

4. Providing passive filters on signals with time constant compatible with scan intervals and overvoltage protection.

5. Eliminating cable splices. Splices in instrumentation and control system signal, network, and instrument manufacturer furnished cables shall be approved in advance by the ENGINEER.

6. Providing a floating output for transmitters that have their own power sources.

G. DC and AC power grounding shall be performed in accordance with the digital hardware manufacturer's recommendations as well as all applicable code requirements.

H. The case of each field instrument and control panel shall be grounded in compliance with the National Electric Code.

I. Power wires shall be separated from parallel-running signal wires by the following minimum spacing:

1. 120 VAC: 12 in

2. 240 VAC: 18 in

3. 480 VAC: 18 in

4. 2000 VAC and above: 24 in

J. The CONTRACTOR shall provide all required cutting, drilling, inserts, supports, bolts, and anchors, and shall securely attach all equipment and materials to their supports. Embedded supports for equipment furnished under this Division shall be provided and installed as shown specified herein and shown on the Drawings.

K. Following acceptance of the factory tests by the ENGINEER, and in accordance with the construction schedule, the CONTRACTOR shall commence installation of the digital control system hardware. Digital system equipment items shall not be installed, however, until all architectural, mechanical, HVAC and electrical Work has been completed in the equipment rooms, MCCs, control rooms and all structural and mechanical Work has been completed within 50 feet of equipment locations.

L. Upon completion of the above construction Work, the CONTRACTOR shall request an inspection of the above-named areas. The ENGINEER will issue a written approval to proceed with delivery and installation only after being satisfied that all Work described

above has been properly performed. Digital equipment shall remain at the factory site or storage prior to approval for delivery to the project site. Partial shipments may be required to meet construction schedule requirements.

- END OF SECTION -

SECTION 17100 – CONTROL AND INFORMATION SYSTEM HARDWARE, GENERAL

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The process control system is physically and functionally distributed between PLC equipped control panels, motor control panels, field panels, operator workstations and appurtenances.

B. Although manual control facilities shall be provided adjacent to each final control element or in local control panels, such facilities are for testing, maintenance and local monitoring purposes only and shall not be regarded as backup to the PLC-based control system.

C. PLCs may be categorized as either “process PLCs” or “integration PLCs” that are provided by the instrumentation subcontractor or “equipment control PLCs” or “vendor PLCs” or “packaged PLCs” provided by equipment manufacturers for the operation of their equipment (blowers, centrifuges, chemical systems, filters, etc.). Unless otherwise specified, all PLCs provided under this Contract shall conform to the requirements specified in this Division.

D. Major plant control system digital equipment items are described in the Specifications and shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 17120 – Programmable Logic Controllers

B. Section 17180 – Process Control System Networks

1.03 DIGITAL HARDWARE CONFIGURATIONS

A. The digital hardware configuration shown on the Control System Architecture Drawing depicts overall system configuration requirements. System design shall be based upon this concept and shall provide an overall digital system availability of 99.8 percent under the conditions specified in Section 17073 – Final Acceptance Test. Unless otherwise specified, designs that vary from this concept will be rejected.

B. All discrete and analog data acquisition, pre-processing, storage and process control functions shall be performed at the PLC level. Run time and flow accumulations shall be performed at the PLC level. Except for minimal calculations related to report-specific functions such as minimum, maximum, average, etc., operator workstations shall not be used to perform calculation for the process control system. Operator workstations shall

be fully independent devices, individually connected to the plant control system networks.

C. No other exceptions will be considered.

PART 2 – PRODUCTS

2.01 GENERAL SYSTEM HARDWARE REQUIREMENTS

A. Unless otherwise specified, all hardware shall be rated for industrial use, resistant to shock, vibration, electromagnetic interference, static discharge, and suitable for the environmental conditions described elsewhere in this Division. Commercial or office grade equipment shall not be accepted.

B. Unless otherwise specified, modular construction shall be employed to simplify maintenance and to provide for future hardware expansion. Plug-in, modular PCB's or modules shall be employed for easy removal to permit exposure of circuit wiring, components and test points. Extender boards shall be provided, if necessary, to permit PCB's to be completely exposed for testing purposes.

C. Keying schemes shall be used to prevent PCB misplacement.

D. The temperature inside each enclosure containing digital hardware (i.e., cabinet, panel or console) shall be continuously monitored and shall generate an alarm to the nearest PLC if the temperature rises to an adjustable, preset high temperature.

2.02 DIGITAL SYSTEM FAILURE DETECTION AND FAIL-OVER REQUIREMENTS

A. No degradation in control system performance shall occur when the system is operating in a partial failure or an equipment fail-over mode. Likewise, no degradation of system performance shall occur while a backed up system component is undergoing preventive or corrective maintenance.

B. All devices connected to the plant control system network shall be self-checking and shall report their operational status to the operator workstations as either "normal" or "failed". A graphic display based on the system architecture drawing shall be furnished with the control and information system showing this information along with current communication status of each device.

PART 3 – EXECUTION

3.01 REQUIREMENTS

A. Refer to Section 17000 – Control and Information System Scope and General Requirements, Part 3.

- END OF SECTION -

SECTION 17120 – PROGRAMMABLE LOGIC CONTROLLERS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. The CONTRACTOR shall furnish, test, install and place in satisfactory operation all programmable logic controllers, 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 17060 – Signal Coordination Requirements

C. Section 17100 – Control and Information System Hardware - General

D. Section 17180 – Process Control System Networks

E. Section 17190 – Uninterruptible Power Systems

F. Section 17500 – Control System Equipment Panels and Racks

1.03 TOOLS, SUPPLIES AND SPARE PARTS

A. Tools, supplies and spare parts shall be provided as specified in Section 17050 - Tools, Supplies, and Spare Parts. In addition, the following specific spare parts items shall be provided:

1. One of each type and size of module for PLC equipment furnished under this Contract.

2. One of each type and size of PLC and equipment power supply furnished under this Contract.

PART 2 -- PRODUCTS

2.01 PROGRAMMABLE LOGIC CONTROLLERS - GENERAL

A. The instrumentation subcontractor shall furnish programmable controllers (PLC's) as specified herein and as shown on the Drawings. PLC's shall be provided complete with backplane, power supply, I/O cards, special function cards, instructions, memory, input/output capacity, and appurtenances to provide all features and functions as described herein. No substitutions will be permitted.

B. All components of the PLC system shall be of the same manufacturer; who shall have fully tested units similar to those being furnished in an industrial environment with associated electrical noise. The PLC system shall have been tested to meet the requirements of

NEMA Standard ICS 2-230 (Arc Test) and IEEE C37.90.1 (SWC). The processing unit shall perform the operations functionally described herein based on the program stored in memory and the status of the inputs and outputs.

C. Programmable controllers shall be designed to operate in an industrial environment. The PLC shall operate in an ambient temperature range of 0°-60°C and a relative humidity of 5-95 percent, non-condensing. The PLC shall operate on supply voltages of 90-132 VAC at 47-63 Hz or 24 VDC if provided with a battery backup system. An integral fuse shall be provided on the power supply for short circuit protection and shall be front panel accessible. Integral overcurrent and undervoltage protection shall be provided on the power supply.

D. Where applicable, the minimum PLC backplane size shall be 7 slots, not including power supply slots.

E. System configuration shall be as shown on Drawing I-2. PLC types shall correspond to the specifications herein. Only a single type of processor shall be supplied for all PLCs of a designated type. Memory and processor shall be adequate for all control functions specified. PLCs shall be as manufactured or equal to the following:

1. Modicon M340

2.02 PROCESSORS

A. The processor and its associated memory shall be enclosed in a modular enclosure. A multiple-position selector switch or equivalent shall be used to select processor operating mode. LED-type indicating lights shall be provided to indicate processor, memory, and battery status. Errors in memory shall be recognized and shall activate the memory error indicating lights. The PLC processor shall monitor the internal operation of the PLC for failure and provide an alarm output. Nonvolatile memory in the form of a manufacturer supplied industrial CompactFlash card or equivalent technology shall be required to maintain the entire current program and firmware of the controller in the event of power loss. The program shall be updated onto the flash memory each time a program change such as an online edit or tag value is changed. When nonvolatile memory (flash memory) is not available for certain controller models as offered by the PLC manufacturer, lithium batteries shall be used to maintain process RAM memory for at least one year in the event of power loss. The lithium battery unit shall be an externally mounted battery assembly with the highest available capacity. The PLC shall send an alarm to the plant control system if battery level is low.

B. The instruction set for the PLC shall conform to the requirements of IEC 61131-3. Each PLC shall have the capability to run all five of the standard IEC 61131-3 languages simultaneously. These five languages shall be:

1. Ladder Diagram
2. Structured Text
3. Instruction List
4. Function Block Diagram
5. Sequential Function Chart

C. Additional co-processors or modules may be necessary and shall be furnished as required to meet the functions specified herein.

D. PLC processors shall be provided with substantial user program, data and logic memory to allow for future expansion of the overall system. The total memory used on each processor shall be less than 60% of available memory at project completion.

2.03 COMMUNICATIONS

A. PLC communications shall be provided as specified in Section 17180 – Process Control System Networks and as shown on the Control System Architecture Drawing.

B. In addition to a communications port for the control system network, communication ports shall be provided for any other devices required (i.e., operator interface unit) plus an additional communication port for connection to a notebook computer.

C. The PLC shall be able to support the Ethernet/IP and Modbus/TCP communication protocol. The CONTRACTOR shall coordinate the efforts of the necessary parties (instrumentation subcontractor and equipment suppliers) to accomplish the required device and data table addressing between each PLC and the associated connected equipment.

D. Additional communication modules or protocol gateways may be required to support specific communication protocols required under this Contract, and shall be supplied at no extra cost to the CITY.

2.04 INPUT/OUTPUT SUBSYSTEMS

A. Input/output hardware shall be plug-in modules in associated I/O backplane/chassis or DIN-rail mounting assemblies. Each unit shall handle the required number of process inputs and outputs plus a minimum of 10 percent active pre-wired spares for each I/O type furnished, plus a minimum of 20 percent spare I/O module space for the addition of future circuit cards or modules.

B. Discrete inputs shall be 24 VDC or 120 VAC signals (integral to the PLC) from dry field contacts. Discrete outputs shall be 24 VDC or 120 VAC outputs sourced from the PLC, or dry relay contacts (2A minimum) as required. Refer to Section 17060 – Signal Coordination Requirements for further details of discrete signal type and voltage requirements. The PLC shall provide momentary and latched outputs as required to interface with motor controls and external devices. Interposing relays shall be provided where required to interface with field equipment. Interposing relays shall be as specified in Section 17550. Electrical isolation shall be provided where required. Maximum density for discrete I/O modules shall be 32 per input module and 16 per output module.

C. Analog input circuits shall be isolated, minimum 16-bit resolution type. Analog input hardware shall be provided as required for all types of analog inputs being transmitted to the PLC. In general, analog input modules shall be capable of receiving 4-20 mA signals. Where required, RTD input modules shall have a minimum resolution of 0.15°C and be capable of accepting signals from 100-ohm Platinum RTD's. Analog outputs shall be

coordinated with the receivers but shall generally be isolated 24 VDC 4-20 mA outputs powered from the PLC. Each input/output circuit shall have optical isolation to protect the equipment against high voltage transients. Optical isolation shall be rated at not less than 1500 V RMS. Lightning/surge protection shall be provided as specified in Section 17560 - Surge Protection Devices. Maximum density for analog I/O modules shall be 8 per module.

D. Input/output modules shall be configured for ease of wiring and maintenance. The modules shall be connected to wiring arms that can be disconnected to permit removal of a module without disturbing field wiring. Covers shall be provided to prevent operator personnel from inadvertently touching the terminals. The process interface modules shall be provided with screw-type terminal blocks with barriers between adjacent terminals for connection of field inputs. Terminals shall be suitable for accepting up to and including No. 14 AWG wire. All DC output circuits to the field shall include fuses, either integral or at the terminal strip. Output failure mode shall be selectable so that upon station or communication system failure all outputs shall be placed either in the non-conducting mode, or remain as were prior to failure. Light-emitting diodes shall be provided for status indication for each input and output point.

E. External power supplies shall be provided with the PLC as required to meet specified installed I/O power requirements plus spares. Power supplies shall be modular units, shall be fully redundant and shall alarm the PLC upon failure. Power supplies shall have a line regulation of 0.05% and meet the environmental and power requirements specified herein for the PLC.

2.05 REMOTE I/O SUBSYSTEMS

A. Remote I/O shall be provided as designated on the Control System Architecture Drawing. Remote I/O shall be either PLC backplane type I/O or field modules as manufactured by the PLC manufacturer. Field modules shall meet the requirements of Subsection 2.04, Input/Output Subsystems. Remote I/O processor or communication modules shall be modular and individually replaceable.

B. Remote I/O shall communicate with the PLC using the PLC manufacturer’s standard protocol or Ethernet IP.

2.06 INPUT/OUTPUT CIRCUIT ARRANGEMENT

A. Signal and control circuitry to individual input/output boards shall be arranged such that board failure shall not disable more than one half of the control loops within any group of controlled equipment (e.g., one pump out of a group of three pumps, two pumps out of four, etc.). Where possible, individual control loops and equipment shall be assigned to individual boards such that failure of the board will disable only one loop or piece of equipment.

2.07 PROGRAMMING SOFTWARE

A. The PLC programming and configuration software shall be the manufacturer's latest, full-featured version, Windows-based, and shall be fully compliant with IEC 61131-3 standards. The software package shall consist of all programming, configuration, and

documentation software needed to place the control and information system in satisfactory operation. The software shall allow on-line and off-line program development and documentation. PLC programming software shall include documentation on optical media.

B. If available, the configuration and programming software shall support communication over the network specified in Section 17180 – Process Control System Networks to implement its functions remotely from an operator workstation. All necessary hardware required to have the operator workstation perform PLC configuration and programming shall be provided.

C. PLC programming software license shall be provided by Owner.

PART 3 - EXECUTION

3.01 REQUIREMENTS

A. PLC programming shall be furnished to perform all functions described in Section 17950 – Functional Control Descriptions, including global functions. In addition, PLCs shall be programmed to provide additional functions described in other sections of this Division.

B. PLC programming shall make use of the various IEC languages as appropriate to the specific task, and shall be performed in a modular style making extensive use of program blocks (subroutines) and program variables to be passed to the program blocks for specific equipment. It is the intent of this requirement to allow for enhanced readability and ease of modification of the program code through the elimination of multiple instances of repeated code for the same function in a “hard-coded” style.

C. Extensive comments shall be placed in the program code to describe the functions of all elements of the program code. PLC code that does not contain comments shall be rejected.

D. Refer to Section 17000, Part 3 for additional requirements.

3.02 REQUIREMENTS FOR MANUFACTURER-SUPPLIED PLCs

A. PLCs that are supplied for equipment local control panels by individual equipment manufacturers or suppliers shall, where so indicated on the Control System Architecture Drawing, be integrated into the plant control system. The manufacturer-supplied PLC shall be furnished, installed and programmed by the manufacturer. The PLC shall continuously monitor and control the associated system and at the same time shall provide all the required alarms, indications of system parameters, equipment status, etc. to the main control system at the plant.

B. Where required as described above, each manufacturer-supplied PLC shall be connected to the Ethernet process control network for access from the plant control system HMI servers, as specified in Section 17180, and shall contain a fiber optic Ethernet switch identical to those provided for the rest of the network-connected PLCs.

C. Each equipment manufacturer shall provide all monitoring and control data to be transferred between the PLC and the plant control system in contiguous blocks of PLC registers to facilitate block read and write commands for efficient scanning by the control system SCADA servers. These contiguous registers shall be arranged in a single data transfer area, which shall be divided into eight distinct areas with an emphasis on flexibility and future expansion. The distinct areas shall be arranged by data type (analog or discrete), transfer direction (server to PLC or PLC to server), and, where applicable, implementation schedule (current or future). Where required, peer-to-peer communication between PLCs shall likewise be accomplished using separate blocks of contiguous registers. Where individual equipment PLCs are not required to be connected to the plant control system via the data highway network, they shall provide the individual hardwired signals as specified in the Contract Documents. Data and commands for connection to the control system are described in the Drawings, the Input/Output Schedule, the individual equipment specification sections, and in Section 17950 – Functional Control Descriptions.

D. The operator interface for control of each individual system shall be performed by local operator interface units as specified in Section 17125 or individual pilot devices on the equipment local control panel, as specified in the associated equipment specification section. Additional operator interface functions shall be provided through the plant control system as specified in the respective equipment specifications and in Section 17950.

E. Where operator interface and control functions are required to be provided through the plant control system, the individual system supplier shall be responsible for coordination with the instrumentation subcontractor to provide a complete and working equipment control system. The individual equipment supplier shall also be responsible for limiting the access of the plant control system to the equipment PLC code so as to prevent malfunctions of the equipment and any failure to continuously perform its intended functions. The equipment supplier shall be responsible for ensuring that no actions by the plant control system can damage or otherwise adversely affect the operation of the associated equipment or the safety of personnel working on or near that equipment. The equipment supplier shall also provide direction in the configuration of the SCADA software's security system by the instrumentation subcontractor to limit access to the control functions of the equipment control system to authorized personnel only. The equipment supplier shall coordinate testing of the completed system with the instrumentation subcontractor, which shall conform to the requirements of Section 17072 – Field Testing.

F. The CONTRACTOR, equipment supplier and instrumentation subcontractor shall coordinate testing and startup of the equipment provided by the equipment supplier with the plant control system, including but not limited to the following tasks:

1. Provide assistance with control system testing of inputs, outputs, and control strategies as needed.

2. Provide support or interface work necessary to perform physical checkout and field testing to the final field devices. The schedule may require the instrumentation subcontractor and equipment manufacturer personnel to perform loop checks simultaneously, as directed by the ENINGEER.

3. Coordinate and assist as needed to maintain I/O connectivity throughout the system.

4. Ensure personnel safety while equipment is exercised via the plant control system.

5. Ensure that process, instrumentation, and control equipment are not damaged while equipment is exercised via the plant control system.

6. Provide temporary modifications to field devices and their terminations, if needed.

7. Providing labor and supervision, which may include, but is not limited to, the following: electricians, instrument technicians, manufacturer's representatives, and individual(s) knowledgeable about process startup and operation.

8. Operation of process equipment for verification of each plant control system input and output.

- END OF SECTION -

SECTION 17125 - OPERATOR INTERFACE UNITS

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish, test, install and place in satisfactory operation all operator interface units (OIU)s, 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 17100 – Digital System Hardware Configuration

C. Section 17120 – Programmable Logic Controllers

1.03 SPARE PARTS

A. Furnish one (1) spare OIU of each make and model specified herein.

PART 2 – PRODUCTS

2.01 OPERATOR INTERFACE UNIT

A. Provide an operator interface unit (OIU) for the following panels:

1. Odor Control System Local Control Panel (LCP-33).

B. OIUs shall be provided to facilitate PLC-33 monitoring and control functions and to display alarm messages using a color touch screen graphical user interface. Each OIU shall provide the following features as a minimum:

1. Display: TFT Color LCD, 800x600 pixels SVGA
2. Touch Type: Analog Resistive
3. Backlight: LED w/ min. 50,000 hr life to half brightness
4. User Software: Vijeo Designer
5. Application Memory: Flash EPROM, 96MB
6. Data Backup: 512kB GB SRAM
7. SD Slot: Secure Digital (SD) card slot with minimum 4GB SD card
8. Interfaces: Minimum one (1) USB 2.0 high-speed Type A host port
9. Network: One 10/100Base-T RJ45 Ethernet port
10. Operating Voltage: 24 VDC

11. Enclosure: PPT, Front 304 Stainless steel, NEMA 4X IP66k front, IP20 back

12. Environment: 0-55˚C, 10-90% relative humidity, non-condensing

C. The OIU-33 operator interface unit shall be 12” Harmony GTO Model HMIGTO6315 with one (1) Vijeo Designer 6.2 software license by Schneider Electric or ENGINEER approved equal.

PART 3 – EXECUTION

3.01 REQUIREMENTS

A. The OIU shall be configured to display all PLC I/O, setpoints, and parameters. All equipment failures shall be alarmed. PLC I/O values and operator-entered setpoints shall be displayed with associated units and service descriptions. Menus shall be provided to navigate between screens of different equipment items. Displays shall be arranged in a hierarchical structure with displays for specific equipment items grouped together. Additional functionality shall be as specified elsewhere in this Division.

B. OIU-33 HMI graphic screens design format shall follow the CITY’s current WWTP HMI graphic standards.

C. All necessary configuration and programming software shall be provided on optical media and turned over to the Owner.

D. Unless otherwise noted, each OIU shall be mounted 60 inches above the floor or work platform. Equipment mounting pad elevation shall be included in the OIU mounting elevation measurement.

E. Refer to Section 17000 for additional requirements.

- END OF SECTION -

SECTION 17180 – PROCESS CONTROL SYSTEM NETWORKS

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The CONTRACTOR shall furnish, test, install and place in satisfactory operation IEEE 802.3 Ethernet local area network(s) for communications among plant devices.

B. Local area network shall be provided with all spare parts, accessories, and appurtenances as herein specified.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 17000 – Control and Information System Scope and General Requirements

B. Section 17120 – Programmable Logic Controllers

1.03 TOOLS, SUPPLIES AND SPARE PARTS

A. The following specific spare parts items shall be provided:

1. One (1) spare industrial ethernet switch of the same make and model furnished for LCP-33 shall be provided by the Odor Control System supplier. The spare shall include two (2) single-mode fiber-optic SFP transceiver modules.

PART 2 – PRODUCTS

2.01 LOCAL AREA NETWORK (LAN)

A. An IEEE 802.3 Ethernet local area network shall be used for communications between plant devices.

B. Network wiring shall be unshielded, twisted-pair copper cables for connections within buildings. Fiber optic media shall be used for all inter-device communication links extended outside of a building, unless specifically noted. Cables shall be as specified herein.

C. The CONTRACTOR may provide a network configuration different from that shown in the Contract Drawings with written approval of the ENGINEER, but the CONTRACTOR shall coordinate with all affected trades and pay for all additional charges incurred.

D. The CONTRACTOR shall supply all hardware, cables, connectors, and software to implement a network as specified herein and shown on drawings.

2.02 ETHERNET NETWORK SWITCHES

A. An industrial Ethernet network switch shall be furnished by the Odor Control Scrubber System supplier in the LCP-33 cabinet and integrated into the CITY's existing in-plant Ethernet network by the Division 17 instrumentation and controls subcontractor. LCP-33 shall be integrated into the in-plant Ethernet network to form a redundant network with self-healing communication recovery. The integration work performed by the instrumentation and controls subcontractor shall include PLC-33 communications configuration and LCP-33 ethernet switch communications configuration and coordination of IP addresses assignment with the CITY's ICE department. The instrumentation and controls subcontractor shall provide IP address assignment requirements and LCP-33 network switch and PLC-33 communications configuration information to the Odor Control Scrubber System supplier's panel builder for configuration by the panel builder prior to LCP-33 delivery to the site. The instrumentation and controls subcontractor shall verify the configuration once the panel has been installed and powered up at the site and shall make any required modifications to the configuration.

B. In addition to configuration of the industrial Ethernet network switch in LCP-33 the Division 17 instrumentation and controls subcontractor shall configure the CITY's existing Ethernet network switch in the Main Control Room to establish the redundant network link, as shown on Drawing I-2 and described herein. The instrumentation and controls subcontractor shall provide single-mode fiber optic SFP port transceivers for the existing switch or stand-alone fiber-to-copper signals converters, as required to establish the communications link.

C. The fiber-optic Ethernet/IP communications link between LCP-33 and the City's existing Main Control Room SCADA network switch shall be a point-to-point network topology that utilizes dual single-mode fiber optic uplink ports (2 fiber-optic pairs) to maintain a fault tolerant connection with seamless automatic failover from a primary to secondary fiber port. The industrial Ethernet network switch in LCP-33 shall support the non-proprietary Media Redundancy Protocol (MRP) and Rapid Spanning Tree Protocol (RSTP) in addition to the switch manufacturer's standard redundant network protocol, all of which shall provide self-healing communication recovery. The redundancy protocol with the fastest recovery time shall be utilized to establish the communications link.

D. Ethernet network switches shall meet the following minimum performance requirements:

1. Functions: managed switch with store and forward switching mode, 10 Mbps Ethernet, 100 Mbps Fast-Ethernet and gigabit Ethernet support, multi-address capability, auto-crossing, auto-negotiation, auto-polarity. Port speed and duplex auto-negotiation shall be configurable. Each network switch shall manage up to eight (8) ports possible via integrated media modules specified below.

2. Management: Simple Network Management Protocol (SNMP) (v1/v2/v3) and Common Industrial Protocol (CIP) support; IGMP filtering and snooping.

3. Power Requirements: Redundant 24 VDC power supply

4. Operating Temperature: 0 to 60 degrees C

5. Relative Humidity: 10 - 95%

6. Port Type & Quantity (at each PLC location): minimum of eight (8) 10/100Base-TX twisted pair cable RJ-45 sockets, 0-100 meters LAN segment and two (2) 100/1000Base-FX, single mode fiber optic LC sockets, 0-5000 meters LAN segment

7. Link Budget: 8 dB @ 1310 nm

8. Wavelength: 1310 nm

E. The LCP-33 LAN Switch shall be Fortinet FortiSwitch FSR-112D-POE Switch Rugged DIN rail type with FN-TRAN-LX SFP modules; no substitutions.

2.03 UNSHIELDED TWISTED PAIR CABLE

A. Unshielded twisted pair cable for drops within buildings shall consist of 4 pair of 24 AWG copper conductors in a flame-retardant jacket. Cable shall be plenum rated (UL 910) and meet EIA/TIA-568 Category 6 specifications. Unshielded twisted pair cable shall be Hyper Grade Extended Distance cable as manufactured by Berk-Tek, Belden equivalent, or equal. Connectors shall be modular RJ-45 plug.

2.04 FIBER OPTIC CABLE

A. CITY shall furnish and install single mode fiber-optic cable between the WWTP Main Control Room and LCP-33, as shown on Drawing I-2, in CONTRACTOR furnished and installed conduits. Refer to the Electrical Drawings for additional requirements.

B. All fiber-optic cable shall be terminated by the CITY in CITY furnished fiber optic patch panels. Odor Control Scrubber System supplier shall provide a minimum of 6” of empty DIN rail space in LCP-33 for a compact patch panel.

C. CITY shall provide fiber optic patch cables, patch panels, fiber-optic transceivers, Ethernet switches or Ethernet switch hardware modifications for SCADA network Ethernet switch in Main Control Room SCADA network rack, shown on Drawing I-2. Division 17 control system subcontractor shall coordinate with CITY and shall provide configuration of the existing or new CITY furnished Ethernet switch as required to integrate LCP-33 (PLC-33) into the SCADA system.

D. Odor Control Scrubber System supplier shall provide single-mode fiber optic, loose tube patch cables with LC connectors to connect LAN switch to CITY furnished fiber-optic patch panel in LCP-33. Patch cables shall be compatible with CITY furnished fiber optic

cable and shall be manufactured by Corning Cable Systems, Optical Cable Corporation, Phoenix Digital, Black Box or Engineer approved equal.

PART 3 – EXECUTION

3.01 REQUIREMENTS

A. The destination of all network data cables (both copper and fiber) leaving an enclosure, patch panel, or building shall be labeled at each end using industry-standard wire markers.

B. Refer to Section 17000 – Control and Information System Scope and General Requirements, Part 3 for additional requirements.

- END OF SECTION -

SECTION 17190 – UNINTERRUPTIBLE POWER SYSTEMS

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The CONTRACTOR shall furnish, test, install and place in satisfactory operation all uninterruptible power systems, with all spare parts, accessories, and appurtenances as herein specified and as shown on the Drawings.

B. One UPS shall be provided for each operator workstation and its peripherals (i.e. printer, network equipment, radio, etc.) provided under this Contract.

C. One UPS shall be provided for each programmable logic controller (PLC) panel or remote telemetry unit (RTU) and its appurtenant equipment provided under this Contract. However, courtesy receptacles in PLC and RTU cabinets shall not be powered by the UPS.

D. UPS units shall be mounted in or near enclosures containing digital hardware, unless otherwise specified or shown on the Drawings, as follows:

1. UPS units for control panels containing PLCs shall be mounted either within the cabinet or in an adjacent cabinet of suitable environmental rating.

E. Where the UPS is mounted within a dedicated enclosure, that enclosure shall be properly sized for heat dissipation and all other applicable requirements as specified in Section 17500 – Control System Equipment Panels and Racks and its subordinate Sections.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 17000 – Control and Information System Scope and General Requirements

B. Section 17100 – Control and Information System Hardware, General

C. Section 17120 – Programmable Logic Controllers

1.03 SUBMITTALS

A. Sizing calculations, in Watts (W) or Volt-Amps (VA), for all UPS units.

B. Heat dissipation calculations for all enclosures that contain a UPS unit.

C. Run time calculation.

PART 2 – EQUIPMENT

2.01 UNINTERRUPTIBLE POWER SYSTEMS

A. Each UPS shall consist of a freestanding UPS module and battery modules as required to meet backup run time requirements.

B. UPS units shall be true on-line type. Each UPS shall be sized to match the maximum power requirements of the associated digital equipment, control panel power supplies and accessories. Under normal operation, the AC power shall be converted to DC. The DC power from the battery charger shall supply an inverter and maintain the battery module at full charge. The AC output from the inverter shall be fed to the associated digital equipment power supply unit and/or other equipment power supplies as appropriate. Upon loss of the AC supply, the inverter shall continue to supply normal power to the device, drawing DC from the batteries.

C. An automatic bypass switch shall be provided with UPS units of greater than 2 kVA capacity. The transfer switch shall be of the solid state, make-before-break type and shall automatically transfer load from the inverter to the AC line in the event of an inverter malfunction. The total transfer time shall be 5 milliseconds or less. The transfer switch shall be provided with a manual override.

D. A manually operated maintenance bypass switch shall be provided for each UPS installation, other than for computers, to allow the hardware to be powered while the UPS is removed for maintenance. The bypass switch shall be the make-before-break type to ensure continuous power to the load.

E. Loss of AC power shall be monitored on the line side of the UPS and reported via normally closed (fail safe) unpowered contacts to the associated PLC/RTU.

F. Each UPS shall meet the following requirements:

1. Input voltage shall be 117 VAC, single phase, 60 Hz.

2. Voltage regulation shall be +/-5 percent for line and load changes.

3. The output frequency shall be phase-locked to the input AC line on AC operation and shall be 60 hertz +/-0.5 percent when on battery operation.

4. The batteries shall be of the sealed, lead acid or lead calcium gelled electrolyte type, or VRLA absorbed glass mat (AGM) type. The battery modules shall have a minimum full load backup time of 30 minutes for PLC-based control panels, and 45 minutes for remote telemetry units.

5. The UPS capacity shall be sized for 150% of the connected load.

6. A status monitoring and control panel shall be provided and shall include the following:

    a. Status indicating lights for both normal and abnormal conditions.

    b. Individual alarm contacts that shall close upon:

        1) Loss of the AC line

        2) Low battery level

        3) Fault condition.

    c. Contacts shall be wired to the closest discrete input subsystem. Alternatively, an RS-232 or USB port shall provide UPS status to an operator workstation. All required interface software and hardware shall be provided.

    d. Circuit breaker for the AC input.

7. Sound absorbing enclosure.

8. EMI/RF noise filtering.

9. Surge protection shall be provided on the AC input circuit, which shall have a UL TVSS clamping voltage rating of 400 V with a <5 ns response time.

G. UPS systems shall be the 9PX series by Eaton, Smart-UPS On-line series by APC/Schneider-Electric, or equal.

PART 3 – EXECUTION

3.01 REQUIREMENTS

A. Where the UPS is mounted within the PLC or RTU cabinet, it shall not interfere with access to other equipment or wiring within the panel (i.e., it shall not be necessary to move or remove the UPS to remove or service other panel-mounted equipment). For floor-mounted PLC cabinets with bottom wiring access (including those cabinets with legs), the UPS shall be placed on a dedicated shelf within the cabinet.

B. Refer to Section 17000 – Control and Information System Scope and General Requirements for additional requirements.

- END OF SECTION -

SECTION 17500 – CONTROL SYSTEM EQUIPMENT PANELS AND RACKS

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The CONTRACTOR shall furnish, test, install and place, in satisfactory operation the control enclosures, with all spare parts, accessories, and appurtenances as specified herein and as shown on the Drawings.

B. Control enclosures shall be assembled, wired, and tested in the instrumentation subcontractor's own facilities, unless specified otherwise. All components and all necessary accessories such as power supplies, conditioning equipment, mounting hardware, signal input and output terminal blocks, and plug strips that may be required to complete the system shall be provided.

C. Either manufacturer’s standard or custom enclosures may be furnished subject to the requirements of the Contract Documents and favorable review by the CITY.

D. Due consideration shall be given to installation requirements for enclosures in new and existing structures. The CONTRACTOR shall examine plans and field inspect new and existing structures as required to determine installation requirements and shall coordinate the installation of all enclosures with the 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).

E. The terms enclosure, cabinet, and panel shall be considered the same product and are used interchangeably.

1.02 SUBMITTALS

A. Submittals shall be per Section 17030 – Control System Submittals.

B. Thermal calculations.

C. Proof of circuit breaker selective coordination.

1.03 RELATED WORK SPECIFIED ELSEWHERE

A. Section 17000 – Control and Information System Scope and General Requirements

B. Section 17100 – Control and Information System Hardware, General

C. Section 17550 – Panel Mounted Instruments

D. Section 17560 – Surge Protection Devices

E. Section 17600 – Unpowered Instruments, General

F. Section 17900 – Schedules and Control Descriptions, General

G. Refer to Division 16 for additional requirements for conductors, circuit breakers, disconnect switches, etc.

1.04 PANEL LOCATION AND TYPE

A. For locations inside buildings in areas other than climate controlled (i.e., heated and air conditioned) electrical or control rooms, panel shall be Type 316 stainless steel NEMA 4X construction, or as indicated for hazardous area classification (Class, Division, at a minimum), or submersible, NEMA 6, applications. Epoxy coated cast copper-free aluminum construction shall also be acceptable for NEMA 4, 6 and 7 applications.

B. For locations in storage/feed areas for chlorine or other applicable corrosive chemicals, panel shall be of non-metallic construction, rated NEMA 4X, and be fully compatible with the associated chemical.

C. For locations within climate controlled (i.e., heated and air-conditioned) electrical or control rooms, panel shall be a painted steel fully enclosed NEMA 12 units with gasketed doors.

D. For outdoor locations, panel shall be polyester powder coated white Type 316L stainless steel NEMA 4X construction unless located in chlorine environments. Chlorine environment shall be nonmetallic NEMA 4X construction.

1.05 TOOLS, SUPPLIES AND SPARE PARTS

A. Tools, supplies and spare parts shall be provided as specified in Section 17050 – Tools, Supplies and Spare Parts, General.

PART 2 – PRODUCTS

2.01 CABINETS AND PANELS

A. Cabinets and panels shall be formed or welded construction, reinforced with Unistrut, Powerstrut, or equal to facilitate mounting of internal components or equipment. Sufficient access plates and doors shall be provided to facilitate maintenance and testing of the cabinet's equipment. Doors shall be removable. Cabinets and panels with any dimension 36 inches or greater shall be provided with removable lifting lugs designed to facilitate safe moving and lifting of the panel during installation. All doors shall be fitted with common-keyed locks.

B. Cabinets and panels shall be minimum 14 USS gauge. Cabinets and panels with any dimension greater than 36 inches shall be 12 USS gauge.

C. Cabinets and panels shall have doors on the front and shall be designed for front access. NEMA 12 cabinets shall be fitted with three-point door latches. Doors for NEMA 4X cabinets shall be all stainless steel with three-point latches. Door hardware on NEMA 4X cabinets located in chemical storage/feed areas shall be non-corrosive in that environment.

D. Panels and cabinets shall be fitted with padlockable latch kits. Coordinate keying with CITY.

E. All cabinets and panels shall be provided with drawing pockets for 11 x 17 as-built panel drawings. One copy of the appropriate laminated panel as-built drawings shall be furnished and left in the pocket of each panel.

F. Panels with any dimension greater than 36 inches that contain a programmable controller (PLC) shall be provided with a folding laptop programmer shelf on the inside of the door. When deployed, the laptop shelf shall not be greater than 48 inches above finished floor. Laptop shelf shall be fitted to door with factory applied weld-studs. Weld discoloration and enclosure penetrations will not be accepted.

G. Unless otherwise noted, panel-mounted control devices (OIUs, hand switches, etc.) requiring operator access shall be mounted between 48 and 60 inches above the floor or work platform.

H. Cabinets and panels shall be prefabricated cabinets and panels by Hoffman or Saginaw Control and Engineering (SCE). The CONTRACTOR may optionally provide cabinets that are custom-fabricated by a reputable panel fabrication shop acceptable to the ENGINEER.

2.02 FIELD PANELS

A. Field panels for outdoor service shall be suitable for wall or pipe mounting. Panels shall have the following features:

1. Hinged and foamed-in-place continuous gasketed door(s). Door material shall match enclosure and shall have piano hinge(s) and three-point latches.

2. Field panels located outside fence-secured areas shall be fitted with staple and hasp. Provide padlock and coordinate keying with CITY.

3. Thermal insulation and thermostatically controlled space heaters where required to prevent condensation or maintain environmental conditions for installed components.

4. External sun shields shall be polyester powder coated white 316S stainless steel, unless otherwise specified. Sun shield or shade shall be fitted to the 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. Refer to the Instrumentation Detail Drawings for additional requirements.

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 an equipment-safety 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 & Engineering (SCE), or equal.

2.03 CABINET AIR CONDITIONING UNITS

A. Where indicated or required due to ambient conditions and panel component ratings, panel-mounted closed loop air conditioning units and thermostatically controlled space heaters shall be provided.

B. Air conditioning units shall both cool and dehumidify the cabinet's internal air. Each air conditioner shall be sized to handle current and future (with specified spare capacity filled) heat loadings from all equipment mounted inside the cabinet.

C. Air conditioners shall be provided with thermostats which operate the centrifugal evaporator blowers continuously to prevent stratification of air within the cabinet. Compressors shall operate as needed to maintain the temperature set at the thermostat. Compressors shall be provided with space heaters to maintain the compressor at a minimum temperature during cold ambient temperatures.

D. Ambient air shall be completely separated from the air inside the cabinet. All air conditioner components exposed to the atmosphere outside the cabinets shall be coated to prevent corrosion.

E. Power supply shall be 115VAC, 60 Hz. Units shall be provided with EMI/RFI noise suppressors.

F. Air conditioner enclosures shall be constructed of stainless steel or cold rolled steel which is phosphatized and finished in baked enamel.

G. Cabinet air conditioners shall be ProAir CR Series as manufactured by McLean Midwest of Brooklyn Park, MN, or equal.

2.04 TERMINAL BLOCKS

A. Terminal blocks shall be assembled on non-current carrying galvanized steel DIN mounting rails securely bolted to the cabinet subpanel. Terminals shall be of the screw down pressure plate type as manufactured by Phoenix Contact, Weidmuller, Wieland, Square D, or equal.

B. Power terminal blocks for both 120 VAC and 24 VDC power shall be single tier with a minimum rating of 600 volts, 30 amps.

C. Signal terminal blocks shall be single tier with a minimum rating of 600 volts, 20 amps.

2.05 NAMEPLATES

A. Items of equipment installed in control panels shall be identified with nameplates. Each nameplate shall be located so that it is readable from the normal observation position and is clearly associated with the device or devices it identifies. Nameplates shall be positioned so that removal of the device for maintenance and repair shall not disturb the nameplate. Nameplates shall include, as necessary, the equipment identification number, description, calibrated range, and set point(s). Abbreviations of the description shall be subject to the ENGINEER’s approval.

B. Nameplates shall be made of 1/16-inch thick machine engraved laminated phenolic plastic having white numbers and letters not less than 3/16-inch high on a black background. Nameplates attached to instruments may be black laser etched 1/8-inch high text on stainless steel with sharp edges made smooth. Stamped text shall not be acceptable.

C. Nameplates shall be attached to metal equipment by NEMA rated stainless steel screws and to other surfaces by an epoxy-based adhesive that is resistant to oil and moisture. In cases where the label cannot be attached by the above methods, it shall be drilled and attached to the associated device by means of a braided stainless steel wire affixed with a permanent crimp.

D. Submit sample nameplate of each type.

PART 3 – EXECUTION

3.01 FABRICATION

A. The cabinet itself and all interior and exterior equipment shall be identified with nameplates. The equipment shall be mounted such that service can occur without

removal of other equipment. Face mounted equipment shall be flush or semi-flush mounted with flat black escutcheons. All equipment shall be accessible such that adjustments can be made while the equipment is in service and operating. All enclosures shall fit within the allocated space as shown on the Drawings.

B. Enclosures shall provide mounting for power supplies, control equipment, input/output subsystems, panel-mounted equipment and appurtenances. Ample space shall be provided between equipment to facilitate servicing and cooling.

C. Enclosures shall be sized to adequately dissipate heat generated by equipment mounted inside the panel. If required, one or more of the following shall be provided to facilitate cooling:

1. For NEMA 12 cabinets only, louvered openings near the bottom and top or thermostatically controlled, low-noise cooling fans to circulate outside air into the enclosure, exhausting through louvers near the top of the cabinet. Air velocities through the enclosure shall be minimized to assure quiet operation.

2. Thermostatically controlled, low noise internal air blowers to circulate air within the enclosure, maintaining a uniform internal temperature. Initial setpoint shall be 75 degrees F.

3. All intake openings in cabinets and panels shall be fitted with dust filters.

D. Enclosures shall be constructed so that no screws or bolt heads are visible when viewed from the front. Punch cutouts for instruments and other devices shall be cut, punched, or drilled and smoothly finished with rounded edges.

E. The temperature inside each enclosure containing digital hardware (e.g., PLC, computer, Ethernet switch) shall be continuously monitored and shall generate an alarm to the nearest PLC if the temperature rises to an adjustable, preset high temperature. This thermostat shall be independent and separate from the thermostat used to control the temperature in the enclosure described above. Enclosure “high interior temperature” alarm shall be displayed on the HMI or OIT.

F. Intrusion alarm switches shall be provided on all enclosures containing digital hardware and shall generate an alarm to the nearest PLC when any enclosure door is opened. If panel contains a service light, alarm switch shall also be wired to turn light on when door is opened.

G. Terminals shall be marked with a permanent, continuous marking strip. One side of each terminal shall be reserved exclusively for field incoming conductors. Common connections and jumpers required for internal wiring shall not be made on the field side of the terminal. Subject to the approval of the ENGINEER, a vendor's pre-engineered and prefabricated wiring termination system will be acceptable.

H. 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.

I. 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.

J. 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 when operating at differing voltages.

K. Spare field wiring shall be bundled, tied, and labeled as specified above, and shall be neatly coiled in the bottom of the cabinet.

L. All installed spare I/O hardware shall be wired along with live I/O wiring to the field wiring terminal blocks within the cabinet. Where space for spare I/O modules has been provided with the PLC backplane or DIN-rail mounting system, corresponding space for wiring, surge protection, and terminations shall be furnished within the cabinet.

M. A copper ground bus shall be installed in each cabinet and shall be connected to the building power ground.

N. 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 – Low Voltage Wire and Cable. Field wiring terminating in panels shall be labeled in accordance with the requirements of Section 16123 – Low Voltage Wire and Cable. Where applicable, the wire number shall be the ID number listed in the input/output schedules.

O. Wires shall be color coded as follows:

1. Equipment Ground – GREEN

2. 120 VAC Power – BLACK

3. 120 VAC Power Neutral – WHITE

4. 120 VAC Control (Internally Powered) – RED

5. 120 VAC Control (Externally Powered) – YELLOW

6. 24 VAC Control – ORANGE

7. DC Power (+) – RED

8. DC Power (-) – BLACK

9. DC Control – BLUE

10. Analog Signal – BLACK/WHITE or BLACK/RED

P. Enclosures shall be provided with a main circuit breaker and a circuit breaker on each individual branch circuit distributed from the panel. Main breaker and branch breaker sizes shall be coordinated such that an overload in a circuit will trip only its immediate breaker and not the upstream breaker.

Q. Enclosures with any dimension larger than 36 inches shall be provided with 120-volt duplex receptacles for service equipment and LED service lights. Power to these devices shall be independent from the PLC power supply and its associated uninterruptible power system.

R. 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.

S. The interconnection between equipment and panel shall be by means of flexible cables provided to permit withdrawal of the equipment from the cabinet without disconnecting the plugs.

3.02 PAINTING/FINISHING.

A. Materials and techniques shall be of types specifically designed to produce a finish of superior quality with respect to adherence, as well as impact and corrosion resistance.

B. Panels fabricated from stainless steel shall be powder coated white.

C. Panels fabricated from non-metallic materials (e.g., FRP) shall be gel-coated and shall not be otherwise painted.

3.03 INSTALLATION

A. Refer to Section 17000 – Control and Information System Scope and General Requirements for additional requirements.

- END OF SECTION -

SECTION 17550 – PANEL MOUNTED INSTRUMENTS

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The CONTRACTOR shall furnish, test, install and place in satisfactory operation the panel mounted instruments, with all spare parts, accessories, and appurtenances as specified herein and as shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 17000 – Control and Information System Scope and General Requirements

B. Section 17100 – Control and Information System Hardware, General

C. Section 17500 – Control System Equipment Panels and Racks

1.03 GENERAL INFORMATION AND DESCRIPTION

A. All equipment mounted on the face of a panel shall conform to the same NEMA rating specified for the panel construction.

1.04 TOOLS, SUPPLIES AND SPARE PARTS

A. Tools, supplies and spare parts shall be provided as specified in Section 17050 – Tools, Supplies, and Spare Parts, General. In addition, the following specific spare parts items shall be provided:

1. One of each type of panel mounted equipment (i.e., indicators, signal converters, etc.) provided under this Contract.

2. Five of each type of interposing control relay provided under this Contract.

PART 2 – PRODUCTS

2.01 OPERATORS

A. Control operators shall be 30.5 mm, round, heavy-duty, oil tight NEMA 4X corrosion resistant. For Hazardous areas, control operators shall be rated NEMA 7.

B. Pushbuttons shall be non-illuminated, spring release type. Pushbuttons shall include a full guard. Panic stop/alarm pushbuttons shall be red mushroom type with manual-pull release. Selector switches shall be non-illuminated, maintained contact type, unless otherwise indicated.

C. Pilot lights shall be of the proper control voltage, push-to-test LED type with lens and LED lamp colors as specified below.

1. Red: stopped, off, or closed

2. Green: running, on, or opened

3. Amber: fault, alarm, or warning

4. White: generic non-alarm status

5. Blue: control power on

D. Control operators shall have legend plates as specified herein, indicated on the Drawings, or otherwise directed by the ENGINEER. Legend plates shall be plastic, black field (background) with white lettering. Engraved nameplates shall be securely fastened above each control operator. If adequate space is not available, the nameplate shall be mounted below the operator.

E. Control operators for all equipment under this Contract shall be of the same type and manufacturer unless otherwise indicated. Control operators such as pushbuttons (PB), selector switches (SS), and pilot lights (PL) shall be Cutler-Hammer/Westinghouse Type E34, Square D Company Type SK, or equal

2.02 ELECTRONIC INDICATORS

A. Electronic indicators shall be 3.5 or 6 digit, as appropriate, with 0.56" high red LED display. Indicators shall be provided with nameplate and scale calibrated to match the calibration of the primary element. The unit shall be designed primarily for use with 4-20 mA current loop signal circuits. The unit shall have the ability to trigger a relay alarm output based on the external set-point value. Indicator operating voltage shall be 115 VAC 10%, 60 Hz. Indicator controls shall include three (3) front-panel pushbuttons for modifying alarm values and other indicator setup. Two (2) form-C relays shall be provided for each indicator. Relay contact outputs shall be rated 5A, 120/240 VAC, resistive load. Where required, a regulated and isolated 24 V excitation power supply shall be provided. Indicators shall be suitable for indoor or outdoor service as required and shall have the same NEMA enclosure rating as the associated enclosure. A smoked polycarbonate transparent cover shall be provided for each electronic indicator.

B. Indicators shall be Red Lion Model IMP or APLCL, Precision Digital, or equal.

2.03 RELAYS

A. Interposing control relays (CR)

1. Where required to interface between motor control centers, equipment controls, and control panels, interposing relays and associated control wiring circuitry shall be furnished and installed to provide the monitoring and/or control functions specified herein.

2. Interposing relays shall be small format type, DPDT, minimum 10 amp, 120 VAC contact rating.

3. Relay coils shall be 120 VAC or 24 VDC as required to interface with equipment.

4. Relays shall have a flag indicator to show relay status, a pushbutton to allow manual operation of the relay, and an internal pilot light to indicate power to the coil.

5. Relays shall be as manufactured by Square D, Potter & Brumfield, Allen-Bradley, or equal.

B. Timing Relays (TR)

1. Timing relays shall be electronic type with 120 VAC coils unless otherwise specified or indicated on the Drawings. Timers shall be provided with a minimum of two SPDT timed output contacts and instantaneous contacts where required. Contact ratings shall be the same as for interposing relays.

2. Timing relays shall be the general purpose plug-in type, Type JCK as manufactured by Square D Company, equivalent by Eaton/Cutler-Hammer, equivalent by Allen-Bradley, or equal.

2.04 TOTALIZERS

A. Totalizing counters shall be provided for flush panel, spring-clip mounting. Face dimensions of the totalizing counters shall be no larger than 1-1/8-inches high by 2-inches wide. Totalizing counters shall contain eight digits. Height of the digits shall not be less than 5/32-inch. Numerals shall be white on a black background. The counter shall be non-resettable and shall be totally compatible for operation on the pulses supplied by the associated instrument or integrator. The totalizing counter shall be capable of a maximum count rate of 25 counts/second.

B. Legend plates shall be provided for each of the totalizing counters with white letters on a black background with legends as specified below.

C. Totalizing counters shall be manufactured by Kessler-Ellis, or equal.

2.05 ALARM HORNS

A. Alarm horns shall be general-purpose type, panel-mounted, and shall be suitable for indoor or weatherproof service, as required. Power supply shall be either 115 VAC or 24 VDC. Horns shall be capable of producing 100 dB at 10 feet and shall have adjustable volume.

B. Horns shall be Vibratone series as manufactured by Federal Signal Corporation, McMaster-Carr equivalent, Edwards Signaling Company equivalent, or equal.

PART 3 – EXECUTION

3.01 REQUIREMENTS

A. Refer to Section 17500 – Control System Equipment Panels and Racks, for additional requirements.

- 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 17120 – Programmable Logic Controllers

D. Section 17500 – Enclosures, General

E. 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. For surge suppression modules within control panels, for each group of up to twenty eight (28) surge suppression modules, provide a DIN rail mounted surge suppressor monitor/control module (or functional equivalent) to indicate and provide common group alert dry contact outputs to the local PLC I/O system for predictive fault monitoring. Individual status outputs shall be provided for device warning and device overload conditions. Each surge suppressor monitor/control module shall also provide the distribution of power for the LED status indication lights on each group of up to twenty eight (28) surge suppression modules serving the control panel field I/O wiring terminal block system.

7. Configure SCADA HMI and LCP-33 for remote status monitoring for each installed surge suppression monitor/control module device. Provide all required additional PLC I/O as necessary to provide the specified surge suppression module group status monitoring functionality.

8. 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 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 ruggedized construction of materials to suit specified environmental conditions. Instruments shall be rugged and 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 316L 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:

   - Instruments that are generally factory calibrated.
   - Instruments that are specified to be factory calibrated.
   - 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 17682 – LEVEL SWITCHES (SLIDING FLOAT TYPE)

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The CONTRACTOR shall furnish, test, install and place in satisfactory operation the float level switches, with all spare parts, accessories, and appurtenances as herein specified and as shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 17000 – Control and Information System Scope and General Requirements

B. Section 17600 – Unpowered Instruments, General

PART 2 – PRODUCTS

2.01 LEVEL SWITCHES (SLIDING FLOAT TYPE)

A. Chemical Service – level switches shall be of the direct acting float-operated design, comprised of a hermetically sealed float assembly that slides vertically on a column containing micro switches with a cable for connecting into a water tight electrical junction box.

B. Micro switches shall be one normally open, 20VA capacity. Float hangers and supports shall be provided as shown on the manufacturer's installation detail drawings.

C. Float switches for leak detection of chemicals in containment sumps shall be Teflon LS-1900TFE Series Single-Point Level Switch as manufactured by Gems Sensors, or equal.

PART 3 – EXECUTION

3.01 REQUIREMENTS

A. Refer to Section 17600 entitled "Unpowered Instruments, General".

- END OF SECTION -

SECTION 17690 – SIGHT LEVEL INDICATORS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. The CONTRACTOR shall furnish, test, install and place in satisfactory operation the sight level indicator, 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 SIGHT LEVEL INDICATORS

A. The sight level indicator shall be isolated from the measured media in a pressure-tight housing. As liquid level rises, a magnet-equipped float within the unit inverts the magnetic flags in the external indicator to “color-side-out.” The flags remain magnetically interlocked in a column until again inverted to “contrasting-side-out” by the float as liquid level falls. Liquid level is indicated by the junction of the “color” and “contrasting” portions of the column.

B. The sight level indicator shall have the following specifications:

1.	Process Fluid Temperature:	32^{o} F to 280^{o} F
2.	Accuracy:	+/- 2.0% of full scale
3.	Max. Process Fluid Pressure:	150 psig at 140^{o} F

C. The body material shall be CPVC. Wetted parts shall be as follows:

1. Housing Float Material and Float Material: CPVC; or compatible with process fluid.
2. Mounting Type: BP.
3. Housing Type: 2” Pipe.
4. Flag Indicator: Plastic; or compatible with process fluid.
5. Connections:
    a. Connection Code T: (T2) Threaded Cap.
    b. Connection Code Sa: (S4) 2” 150# FF ANSI Flange.
    c. Connection Code Sb: (S4) 2” 150# FF ANSI Flange.

d. Connection Code B: (B2) Threaded Cap.

D. CONTRACTOR shall ensure that Sight Level Indicator is fully supported and protected, and that all signal wiring is installed in conduit as required by the Drawings and Specifications.

E. CONTRACTOR shall facilitate coordination between chemical storage tank, TK-60011 and TK-60031, supplier, Sight Level Indicator supplier and instrumentation and controls subcontractor to ensure compatibility and liquid level measurement accuracy as required in this specification. CONTRACTOR shall maintain ultimate responsibility for the compatibility and accuracy of all Sight Level Indicators furnished under this project.

F. CONTRACTOR shall purchase and ship each Sight Level Indicator to the tank manufacturer for installation by the tank manufacturer.

G. Sight Level Indicators shall be Model Suresite Level Indicators as manufactured by Gems Sensors, or equal.

PART 3 -- EXECUTION

3.01 REQUIREMENTS

A. Refer to Section 17600 entitled “Unpowered Instruments, General”.

- END OF SECTION –

SECTION 17700 – POWERED INSTRUMENTS, GENERAL

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. The Instrumentation Subcontractor 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. The CONTRACTOR may elect to install primary elements (flowmeters, etc.) on process lines provided that the Instrumentation Subcontractor provides full on-site supervision during installation. Mounting of associated transmitters, indicators, power supplies, brackets and appurtenances shall be provided as specified herein and shown on the Drawings.

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. The Instrumentation Subcontractor shall supervise installation of equipment provided under this Division where installation is provided by others.

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 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. Powered instruments furnished with mechanical equipment shall be furnished, installed, tested, and calibrated as specified elsewhere in the Contract Documents.

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, 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 quality and shall be entirely designed and suitable for the intended services. All materials used in fabricating the equipment shall be new and undamaged.

1.04 TOOLS, SUPPLIES AND SPARE PARTS

A. Tools, supplies and spare parts shall be provided as specified in Section 17050.

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 field instrumentation for outdoor service shall be provided with enclosures which are suitable for outdoor service, as follows:

1. Where the manufacturer's enclosures are suitable for outdoor service, they shall be provided with instrument sun shades. Sun shades shall be Style E as manufactured by O'Brien Corporation, or equal. Where possible, these instruments shall be mounted in a north facing direction.

2. Where the manufacturer's standard enclosures are not suitable for outdoor service, instruments shall be mounted in Field Panels in accordance with Section 17500, Control System Equipment Panels and Racks, or may be furnished with Vipak instrument field enclosures as manufactured by O'Brien Corporation, equivalent by Intertec, or equal. It shall not be necessary to provide the manufacturer's NEMA 4 or 4X enclosures for instruments which will be subsequently mounted in separate field panels.

D. All instruments shall return to accurate measurement without manual resetting upon restoration of power after a power failure.

E. Unless otherwise shown or specified, local indicators shall be provided for all instruments. Where instruments are located in inaccessible locations, local indicators shall be provided

and shall be mounted as specified in 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.

F. Unless otherwise specified, field instrument and power supply enclosures shall be 316 stainless steel, fiberglass, or PVC coated copper free cast aluminum NEMA 4X construction.

G. Where separate elements and transmitters are required, they shall be fully matched, and unless otherwise noted, installed adjacent to the sensor. Special cables or equipment shall be supplied by the associated equipment manufacturer.

H. Electronic equipment shall utilize printed circuitry and shall be coated (tropicalized) to prevent contamination by dust, moisture, and fungus. Solid-state components shall be conservatively rated for long-term performance and dependability over ambient atmosphere fluctuations. Ambient conditions shall be -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.

I. All devices furnished hereunder shall be heavy-duty type, designed for continuous industrial service. The system shall contain products of a single manufacturer, insofar as possible, and shall consist of equipment models which are currently in production. All equipment provided, where applicable, shall be of modular construction and shall be capable of field expansion.

J. All non-loop-powered instruments and equipment shall be designed to operate on a 60 Hz 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.

K. 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.

L. 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 Instrumentation Subcontractor shall examine the Drawings and Shop Drawings for various items of equipment in order to determine the best arrangement for the work as a whole and shall supervise the installation of process instrumentation supplied under this Division.

2. 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 two-inch diameter aluminum pipe stands welded to a 10-inch square 1/2-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 1/2-inch by use of phenolic spacers. Expansion anchors in walls shall be used for securing equipment or wall supports to concrete surfaces. Unless otherwise noted, field instruments shall be mounted between 48 and 60 inches above the floor or work platform.

2. Embedded pipe supports and sleeves shall be schedule 40, 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 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

1. Electrical, control and signal wiring connections to transmitters and elements mounted on process piping or equipment shall be made through liquid-tight flexible conduit. Conduit seals shall be provided where conduits enter all field instrument enclosures and all cabinetry housing electrical or electronic equipment.

3.02 ADJUSTMENT AND CLEANING

A. General

1. The Instrumentation Subcontractor 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 their 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 their responsibility for meeting all specified requirements.

2. The Instrumentation Subcontractor shall provide the services of factory trained technicians, tools and equipment to field calibrate, test, inspect and adjust each instrument to its specified performance requirement in accordance with manufacturer's specifications and instructions. 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 Instrumentation Subcontractor 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 Instrumentation Subcontractor 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 overvoltages, 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 Instrumentation Subcontractor shall perform a loop check. The CONTRACTOR shall submit final loop test results with all instruments listed in the loop. Loop test results shall be signed by all representatives involved for each loop test.

- END OF SECTION -

SECTION 17745 - RADAR LIQUID LEVEL MEASUREMENT SYSTEMS

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish, test, install and place in satisfactory operation the radar liquid level measurement systems, with all spare parts, mounting brackets, accessories, and appurtenances as herein specified and as shown on the Drawings.

B. Spare Parts:

1. Provide one spare radar liquid level measurement controller/display unit and one spare sensor/transmitter of the same make and model of the units furnished under this contract.

PART 2 – PRODUCTS

2.01 GENERAL REQUIREMENTS

1. The radar liquid level measurement sensor/transmitter shall operate on the frequency modulated continuous wave (FMCW) radar signaling technology at approximately 80 GHz frequency sweep. Sensor accuracy shall be a minimum of ±0.2 mm. Resolution shall be at least 0.1 percent of full range.

2. Radar level controller/display unit shall be remotely mounted from the sensor and shall include a remote digital display and operator interface that allows complete field configuration of all settings and control modes of the system. The transmitter shall compensate for temperature and air density. The unit shall provide level monitoring and volumetric calculation. Output level signal shall be linear, isolated 4 20 mA DC with HART. The units shall have as a minimum, the required number of programmable set points to perform the functions specified. The controller/display unit shall have a NEMA 4X enclosure.

2.02 RADAR LEVEL SENSOR/TRANSMITTER (TRANSDUCER)

A. Each radar level measurement system shall include a radar level sensor/transmitter with the following specifications:

1. Housing:

a. Plastic

2. Sensor Materials/Wetted Parts: PVDF

3. Seal Material: FKM

4. Cable Entry:

    a. 1/2 inch NPT

5. Signal : Two-wire 4-20mA/HART

6. Radar Beam Angle: 8°

7. Radar Frequency: 80 GHz

8. Radar Range: 0-49.2’

9. Antenna: Submit dimensions of each chemical tank, radar sensor mounting location and radar beam obstructions and all other relevant information to radar manufacturer and provide a plastic horn antenna for sensors as recommended by radar manufacturer.

10. Display: black and white LCD matrix display

11. Approvals: c-UL-us, IEC

12. ID Tag: Stainless Steel with tag number “LE-XXXXX”

13. Certificates: factory approved inspection certificate with test data

14. Mounting Hardware:

    a. All attachment parts shall be suitable for the environment in which they are installed.

    b. Non-contact radar sensor installation:

        1) Both custom and manufacturer provided bracket systems must be long enough to place the sensor in a position over the tank recommended by the radar manufacturer and as described in the Instrumentation detail drawings to minimize radar signal reflections or obstructions in the path of the radar sensors expanding, conical beam.

        2) For Non-conductive plastic and FRP chemical storage/day tanks provide an FRP strut bracket system mounted to a wall or nearby permanent structure to hand the sensor over the tank to provide a non-contact installation.

            a) For corrosive chemicals, such as sodium hypochlorite, provide a custom, chemical resistant FRP strut system with wall, ceiling or tank blind flange mounting bracket.

b) For non-corrosive chemicals only, a manufacturer supplied 316L stainless steel mounting angle with adjustable bracket is acceptable for wall mounting the sensor in non-contact installations.

3) All mounting angle, bracket materials and fasteners must be suitable for the chemical and environment in which they are being installed.

4) Submit a mounting system detail for each radar sensor for approval by Engineer.

B. The radar sensor/transmitter shall be suitable for operating in ambient temperature range of -40 to + 158 °F.

C. Each Radar level sensor/transmitter unit shall be an VEGAPULS C21 as manufactured by VEGA or Engineer Approved Equivalent.

2.01 RADAR LEVEL CONTROLLER/DISPLAY UNIT (REMOTE MOUNT)

A. Each radar level measurement system shall include a radar level measurement controller/display unit with the following minimum specifications:

1. Enclosure Protection Rating: IP66/IP67, Type 4X
2. Input Power: 120 VAC, 60 Hz.
3. Operating Temperature Range: -40F to +140 degrees F
4. 1 x 4-20 mA sensor input
5. 3 x operating relay
6. 1x failure relay (instead of operating relay)
7. Approvals: c-UL-us, IEC
8. Hazardous Area Approvals:
    a. None.
9. Cable Entry: 1/2 inch NPT
10. Mounting: Stanchion (pipe mount)
11. Indication:
    a. Black and white LCD matrix display. Values shall be easy-to-read

display from a distance in sunlight and darkness

b. Backlight with configurable color change for level status alarms

12. Adjustment:

a. On-site adjustment at the unit

b. Smartphone / Tablet / PC via Bluetooth

13. Sunshield: Custom aluminum or 316 stainless steel powder coated white

14. ID Tag: Stainless Steel with tag number “LIT-XXXXX”

15. Certificates: factory approved inspection certificate with test data

B. Each Radar level measurement controller/display unit shall be model VEGAMET 841 as manufactured by VEGA or Engineer Approved Equivalent.

PART 3 – EXECUTION

3.01 REQUIREMENTS

A. Radar level sensor/transmitter units shall be mounted in accordance with radar manufacturer recommendations and as shown on the Instrumentation Detail drawings.

B. Radar level controller/display units shall be mounted on an aluminum stanchion per the Instrumentation Detail drawings.

C. All radar liquid level measurement systems are to be full tested by filling each chemical storage tank with water, prior to filling the tank with chemical.

D. CONTRACTOR shall perform a live demonstration of the radar instrument configuration using the manufacturer’s Bluetooth smartphone or tablet app. The CONTRACTOR shall also demonstrate local configuration from both the radar sensor/transmitter and controller/display unit using the displays buttons and magnetic wand.

E. See Section 17560 for surge suppressor product requirements for analog signals.

F. Refer to Section 17700 – Powered Instruments for additional requirements.

G. Include factory calibration test certificates in shop drawing submittal to Engineer for each instrument.

END OF SECTION

SECTION 17760 - PRESSURE TRANSMITTERS

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish, test, install and place in satisfactory operation the pressure transmitters, with all spare parts, accessories, and appurtenances as specified and as shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 17000 – Control and Information Systems Scope and General Requirements

B. Section 17600 – Unpowered Instruments, General

PART 2 – PRODUCTS

2.01 GAUGE PRESSURE INDICATING TRANSMITTERS

A. Gauge pressure transmitters shall have piezoresistive measuring cells with a metallic or ceramic process isolating diaphragm directly in contact with the process liquid. Silicone oil fill fluid shall be used to transfer the pressure from the process isolating diaphragm to the measuring cell. Calibrated span and zero shall be continuously adjustable externally over the entire range. Span and zero adjustments shall be capable of being disabled internally. The maximum zero elevation and maximum zero suppression shall be adjustable to anywhere within sensor limits. Factory set correction coefficients shall be stored in the sensor's non-volatile memory for correction and linearization of the sensor output in the electronics section.

B. Transmitters shall meet the following requirements:

1. Housing: NEMA 4X with low copper, die-cast aluminum body, epoxy coated

2. Wetted Materials: Type 316 stainless steel unless otherwise indicated or required for process fluid compatibility

3. Accuracy: +/- 0.04% of calibrated span

4. Rangeability: 100:1

5. Damping: 0 to 100 seconds, adjustable

6. Output: Linear and isolated 4-20 mA with HART communication protocol

7. Power Supply: 24 VDC, 2-wire loop powered

8. Display: 4-digit (minimum) LCD

9. Overpressure Protection: Yes

10. Ambient Conditions: -40 to 85 degrees C; 0 – 100% relative humidity

11. Operating Temperature: -40 to 100 degrees C

12. Process Connection: 1/2" FNPT

C. All mounting flanges, diaphragms, O-rings and materials used in construction shall be non-corroding and compatible with each other and compatible with the liquid being measured.

D. The piezoresistive silicon pressure sensor shall be mechanically, electrically, and thermally isolated from the process and the environment. Factory set correction coefficients shall be stored in the sensor's non-volatile memory for correction and linearization of the sensor output in the electronics section. The electronics section shall correct the digital signal from the sensor and convert it into a 4-20 mA analog signal for transmission to receiving devices. The electronics section shall contain configuration parameters and diagnostic data in non-volatile EEPROM memory and shall be capable of communicating, via a digital signal superimposed on the 4-20 mA output signal, with a remote interface device.

E. Gauge pressure indicating transmitters shall be furnished with 316 stainless steel two-valve manifold assembly where a block valve provides instrument isolation and a drain/vent valve allows venting, draining, or calibration. Two-valve manifold assembly shall be Model 306 Series as manufactured by Rosemount, or equivalent by instrument manufacturer.

F. Gauge pressure indicating transmitters shall be Model 3051S as manufactured by Emerson Process Management (Rosemount), Siemens Sitrans P410, Endress + Hauser Model Cerabar S PMP71 Platinum, or equal.

2.02 DIFFERENTIAL PRESSURE INDICATING TRANSMITTERS

A. Differential pressure indicating transmitters shall be the same as the gauge pressure transmitters except for body specifications. Differential pressure units shall be furnished with close coupled 316 stainless steel three-valve manifold valve assembly complete with drain/vent ports. Integral manifold assembly shall be Model 305 Series as manufactured by Rosemount, or equivalent by instrument manufacturer.

B. Each differential pressure transmitter shall be furnished with stainless steel mounting brackets and hardware.

C. The electronics sections of differential pressure transmitters shall contain user-selectable square root extractors to provide a linear 4-20 mA DC output

proportional to flow, when activated. Square root extractor circuitry shall be activated only for incompressible fluid flow applications (e.g., water). Flow rates for compressible fluids (e.g., air) shall be calculated externally using line temperature and static pressure corrections as specified elsewhere. In addition, each flow transmitter shall be furnished with laminated flow versus differential pressure curves wall mounted adjacent to the transmitter.

D. Differential pressure indicating transmitters shall be Model 3051S as manufactured by Emerson Process Management (Rosemount), Siemens Sitrans P410, Endress + Hauser Model Deltabar S PMD75 Platinum, or equal.

PART 3 – EXECUTION

3.01 REQUIREMENTS

A. Refer to Section 17600.

END OF SECTION

SECTION 17900 – SCHEDULES AND CONTROL DESCRIPTIONS, GENERAL

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The CONTRACTOR shall furnish, test, install and place in satisfactory operation all hardware and software required to provide the Control and Information System as specified herein and as shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 17910 – Instrument Schedule

B. Section 17920 – Control System Input/Output Schedule

C. Section 17950 – Functional Control Descriptions

PART 2 – CONVENTIONS

2.01 PLANT NUMBERING SYSTEM

A. The plant equipment numbering system is a five digit system.

PART 3 – EXECUTION (NOT USED)

- END OF SECTION -

SECTION 17910 - INSTRUMENT SCHEDULE

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish, test, install and place in satisfactory operation all instrumentation as herein specified and as shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 17900 – Schedules and Control Descriptions

B. Section 17920 – Control System Input/Output Schedule

C. Section 17950 – Functional Control Descriptions

PART 2 – PRODUCTS

2.01 NAMEPLATES

A. Items of equipment listed in the instrument schedule, control panels, and digital hardware items shall be identified with nameplates. Each nameplate shall be located so that it is readable from the normal observation position and is clearly associated with the device or devices it identifies. Nameplates shall be positioned so that removal of the device for maintenance and repair shall not disturb the nameplate. Nameplates shall include, as necessary, the equipment identification number, description, calibrated range, and set point(s). Abbreviations of the description shall be subject to the Engineer's approval.

B. Nameplates shall be made of 1/16-inch thick machine engraved laminated phenolic plastic having white numbers and letters not less than 3/16-inch high on a black background. Nameplates attached to instruments may be black laser etched 1/8-inch high text on stainless steel with sharp edges made smooth. Stamped text shall not be acceptable.

C. Nameplates shall be attached to metal equipment by NEMA rated stainless steel screws and to other surfaces by an epoxy-based adhesive that is resistant to oil and moisture. In cases where the label cannot be attached by the above methods, it shall be drilled and attached to the associated device by means of a braided stainless steel wire affixed with a permanent crimp.

D. Submit sample nameplate of each type.

PART 3 – INSTRUMENT SCHEDULE

Level Switches (Sliding Float) - Section 17682			
Tag Number	**Service Description**	**State/Span**	**Remarks**
LAH-60055	Odor Control Containment Sump High Level Switch	Alarm	Mount ½" from containment sump floor.
Sight Level Indicators - Section 17690			
Tag Number	**Service Description**	**State/Span**	**Remarks**
LG-60011	NaOH Storage Tank Sight Level Gauge	Per Tank Manufacturer	Coordinate with Tank Manufacturer.
LG-60031	NaOCl Storage Tank Sight Level Gauge	Per Tank Manufacturer	Coordinate with Tank Manufacturer.
Radar Level Measurement Systems - Section 17745			
Tag Number	**Service Description**	**State/Span**	**Remarks**
LT/LIT-60011	NaOH Storage Tank Radar Level	0-850 gallons	
LT/LIT-60031	NaOCl Storage Tank Radar Level	0-3,000 gallons	

- 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 as herein specified and as shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 17900 – Schedules and Control Descriptions, General

B. Section 17910 – Instrument Schedule

C. Section 17950 – Functional Control Descriptions

PART 2 – CONTROL SYSTEM INPUT / OUTPUT SCHEDULE

Tag Number	Service Description	State/Span	Type	Drawing
YLR-60002	Odor Control Fan Motor	Running	DI	I-3
YA-60002	Odor Control Fan Motor	Overload	DI	I-3
TAH-60002	Odor Control Fan Motor	Motor Overtemp.	DI	I-3
YCR-60002	Odor Control Fan Motor	Start/Stop	DO	I-3
YL-60002	Odor Control Fan Motor	In Remote	DI	I-3
YCR-60011	Stage 1 NaOH Metering Pump	Enable	DO	I-3
YL-60011	Stage 1 NaOH Metering Pump	In Remote	DI	I-3
YA-60011	Stage 1 NaOH Metering Pump	Fault	DI	I-3
SC-60011	Stage 1 NaOH Metering Pump	Speed Command (0-100%)	AO	I-3
SI-60011	Stage 1 NaOH Metering Pump	Speed Feedback (0-100%)	AI	I-3
YCR-60021	Stage 2 NaOH Metering Pump	Enable	DO	I-3
YL-60021	Stage 2 NaOH Metering Pump	In Remote	DI	I-3
YA-60021	Stage 2 NaOH Metering Pump	Fault	DI	I-3
SC-60021	Stage 2 NaOH Metering Pump	Speed Command (0-100%)	AO	I-3
SI-60021	Stage 2 NaOH Metering Pump	Speed Feedback (0-100%)	AI	I-3
AI-60001	Stage 1 Sump pH	0-14	AI	I-3

Tag Number	Service Description	State/Span	Type	Drawing
YLR-60001	Stage 1 Recirculation Pump Motor	Running	DI	I-3
YA-60001	Stage 1 Recirculation Pump Motor	Overload	DI	I-3
YCR-60001	Stage 1 Recirculation Pump Motor	Start/Stop	DO	I-3
YL-60001	Stage 1 Recirculation Pump Motor	In Remote	DI	I-3
LAL-60001	Stage 1 Sump	Low Level Alarm	DI	I-3
LAL-60002	Stage 2 Sump	Low Level Alarm	DI	I-3
YLR-60001	Odor Control System	Running	DI	I-3
YCR-60001	Odor Control System	Start/Stop	DO	I-3
YA-60001	Odor Control System	Common Alarm	DI	I-3
YLR-60002	Stage 2 Recirculation Pump Motor	Running	DI	I-3
YA-60002	Stage 2 Recirculation Pump Motor	Overload	DI	I-3
YCR-60002	Stage 2 Recirculation Pump Motor	Start/Stop	DO	I-3
YL-60002	Stage 2 Recirculation Pump Motor	In Remote	DI	I-3
AI-60003	Stage 2 Sump ORP	1500 mV to -1500 mV	AI	I-3
AI-60002	Stage 2 Sump pH	0-14	AI	I-3
YA-60017	Stage 2 NaOH Metering Pump No. 1	Fault	DI	I-3
LI-60031	NaOCl Storage Tank	Level	AI	I-3
LI-60011	NaOH Storage Tank	Level	AI	I-3
LAH-60055	Odor Control Containment Sump	High Level Alarm	DI	I-3
FAH-60052	Odor Control Containment Area Eyewash	High Flow Alarm	DI	I-3
FAH-60053	Odor Control Eyewash	High Flow Alarm	DI	I-3
YLR-63311	Air Compressor No. 1	Running	DI	I-4
YA-63311	Air Compressor No. 1	Fail	DI	I-4
YLR-63312	Air Compressor No. 2	Running	DI	I-4
YA-63312	Air Compressor No. 2	Fail	DI	I-4
YA-63311	Air Dryer	Common Alarm	DI	I-4
LI-60011	NaOH Storage Tank	Level	AI	I-4
LI-60031	NaOCl Storage Tank	Level	AI	I-4
YA-60061	LCP-33 120V UPS	Low Battery	DI	N/A
YA-60062	LCP-33 120V UPS	Loss of AC	DI	N/A
YA-60063	LCP-33 120V UPS	Fault	DI	N/A
YA-60065	LCP-33 Surge Bank 1	Warning	DI	N/A

Tag Number	Service Description	State/Span	Type	Drawing
YA-60066	LCP-33 Surge Bank 1	Alarm	DI	N/A
YA-60067	LCP-33 Surge Bank 2	Warning	DI	N/A
YA-60068	LCP-33 Surge Bank 2	Alarm	DI	N/A
YA-60071	LCP-33 24VDC Power Supply No. 1	Fail	DI	N/A
YA-60072	LCP-33 24VDC Power Supply No. 2	Fail	DI	N/A
YA-60081	LCP-33 Panel Door 1 Intrusion	Alarm	DI	N/A
YA-60081	LCP-33 Panel Door 2 Intrusion	Alarm	DI	N/A

1. NOTES: Input/Output types are as follows:
    a. DI – Discrete Input
    b. DO – Discrete Output
    c. AI – Analog Input
    d. AO – Analog Output

PART 3 – EXECUTION (NOT USED)

- END OF SECTION -

SECTION 17950 - FUNCTIONAL CONTROL DESCRIPTIONS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. The CONTRACTOR shall furnish, test, install and place in satisfactory operation all control strategies, real time and historical databases, HSI interfaces, HSI linkages to databases and related programming as herein specified and as shown on the Drawings.

B. Together with the control system input/output schedule, the equipment specifications (including functional descriptions for local equipment control panels), and the Drawings, the functional control descriptions describe the required operation, monitoring, and control of the facilities included in this Contract.

C. All equipment and services required to be installed in equipment local control panels provided to implement the monitoring and control functions described herein or in the process input/output schedules shall be provided by the CONTRACTOR through the instrumentation subcontractor or individual equipment suppliers, as appropriate.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 17920 - Control System Input / Output Schedule

PART 2 -- FUNCTIONAL CONTROL DESCRIPTIONS, GENERAL

2.01 DEFINITIONS

A. RUNNING status signals shall be from auxiliary contacts (or data link registers) provided with the motor control equipment (i.e., starter, VFD, SCR, etc.), which shall close (or change value) when the equipment is running.

B. AUTO status signals shall be defined as HAND-OFF-AUTO switch in the AUTO position where LOCAL hardwired automatic control is provided. Alternatively, the AUTO status may be a virtual input where the process control system control strategy is in the AUTO (versus MANUAL) mode where equipment is remotely controlled by the process control system.

C. FAULT status signals shall be defined as motor overload and/or any other shut down mode such as over torque, over temperature, low oil pressure, high vibration, etc.

D. REMOTE (versus LOCAL) status signal shall be defined as a dry contact which indicates that equipment control power is energized and the HAND-OFF-REMOTE switch is in the REMOTE position to permit remote control by the process control system.

2.02 CONVENTIONS

A. Operator Workstation graphic display symbols and indicator lights on all MCC's, control panels, starter enclosures, etc. shall conform to the following color convention:

Condition	Color
Running / On / Open	Green
Off / Closed (in local)	Grey
Off / Closed (in remote)	Red
Fault	Amber
Generic Status	Blue or White

2.03 PROCESS CONTROL

A. Where set points, operating limits, and other control settings are provided by the functional descriptions, these settings shall be initial settings only and shall be used for assistance in the initial startup of the plant. All such settings shall be fully adjustable and, based on actual operating conditions; the instrumentation subcontractor shall make all necessary adjustments to provide smooth, stable operation at no additional cost to the OWNER.

B. Provision shall be made in PLC logic to suppress nuisance alarms and control actions by the following means:

1. For alarms and control actions derived from analog input signals, use adjustable time delays and dead bands.

2. For alarms and control actions derived from discrete input signals, use adjustable time delays.

3. Initial settings for time delays shall be 10 seconds (range 0-120 seconds). Initial settings for dead bands shall be 5 percent of span (range 0-100%).

4. Equipment, which is started or stopped manually by the operator, shall start or stop immediately, with no time delay.

C. All setpoint control shall be by PID control algorithms. Where only proportional control is specified, tuning constants shall be used to reduce the Integral and Derivative functions to zero. All setpoints, sequence times, sequence orders, dead bands, PID tuning parameters, PLC delay timers, variable speed operating range limits, and similar control constants shall be accessible and alterable from the Control Panel Interface or Operator Workstation as shown or scheduled.

D. All PLC-controlled equipment shall be provided with adjustable (0-60 seconds) start and stop delays in the PLC control logic. Unless otherwise specified, these delays shall be initially set at one second. Unless otherwise specified, all equipment shall automatically restart after a power failure utilizing adjustable start delay timers in MCC's and equipment control panels. Unless otherwise specified, all PLC control strategies shall be based upon automatic restart after a power failure and shall return to a normal control mode upon restoration of power.

E. The PLC shall be capable of receiving initial run-time values for existing and proposed equipment. Initial run-time shall not automatically be assumed to be zero. All run-time calculations shall be performed at the PLC level and maintained in the PLC data table.

F. Equipment failure shall be generated through the PLC for any drive, motor, etc. for which a run command has been issued, but for which the PLC is not receiving a run status signal. The failure to start status registers shall be available in the PLC data table for polling.

G. Individual discrete instrument failure signals shall be generated by the PLC for each instrument which is generating a signal less than 4 mA or greater than 20 mA. The instrument failure registers shall be available in the PLC data table for polling.

H. A PLC control program that controls multiple pieces of equipment shall not be prevented from running because not all of the equipment is in REMOTE and/or if equipment in REMOTE is not all in the AUTO mode. If equipment within an equipment chain is required to be running for program operation and it is running in LOCAL or MANUAL, then the program shall run and control the other equipment that is in AUTO.

PART 3 -- FUNCTIONAL CONTROL DESCRIPTIONS

3.01 OVERVIEW

A complete Section 13253 Odor Control Scrubber System Supplier furnished PLC panel, LCP-33, shall be integrated into the existing GE iFix WWTP SCADA HMI and GE Historian by the Division 17 instrumentation and controls subcontractor. Refer to Section 13253 for additional requirements.

The Division 17 instrumentation and controls subcontractor shall develop new SCADA HMI graphic screens for the Odor Control Scrubber System and Instrument Air Supply System. The new HMI graphic screens shall be visually and functionally interchangeable with the Odor Control Scrubber System supplier furnished local OIU-33 HMI graphic screens. The instrumentation and controls subcontractor shall coordinate with the Odor Control Scrubber System supplier's PLC-33 logic and OIU-33 graphics programmer to ensure that all control functions, set-points and system status indications available to the operator from LCP-33 are also available to the operator from the SCADA HMI graphics screens. The OIU-33 and SCADA HMI graphics shall closely follow the CITY's current WWTP SCADA HMI graphic screen standards.

Existing PLC-17, located in the WWTP Main Control Room, contains the existing odor control and instrument air logic. Prior to making any hardware or software modifications to the existing PLC-17 panel or existing SCADA HMI system, the instrumentation and controls subcontractor shall review the PLC-17 logic for any interlocks, program functions or variables shared with other PLCs in the WWTP that may affect other WWTP processes. Once the new Odor Control Scrubber System and Instrument Air System SCADA HMI graphic screens and PLC-33 logic are fully operational, the Division 17 instrumentation and controls subcontractor shall delete any existing Odor Control Scrubber System and Instrument Air System PLC logic in existing PLC-17, delete the old graphics screens, and modify the SCADA historian to record all of the new tags added under this contract in accordance with the CITYs existing standards for data logging.

3.02 CONTROL DESCRIPTIONS INDEX

3.03 ODOR CONTROL SODIUM HYDROXIDE & SODIUM HYPOCHLORITE UNLOADING SYSTEM

A. Drawings I-3 and I-4

B. Control Description

A Chemical Filling Station Local Alarm Panel LAP-60011 shall provide Sodium Hydroxide Storage Tank, TK-60031, and Sodium Hypochlorite Storage Tank, TK-60031, local level indication and local level alarm indication and annunciation. The panel shall be equipped with and electronic indicator, as specified in Section 17550-2.01, that shall receive and display the 4-20mA radar level signals from PLC-33. Refer to detail on Drawing I-7 for additional requirements.

LAP-60011 shall be equipped with relay logic to facilitate the alarm logic described herein below.

Maximum Fill Level Warning – for each storage tank, a digital, 24VDC Maximum Fill Level Warning signal shall be received by LAP-60011 from PLC-33. This signal shall be utilized by the relay logic in LAP-60011 to illuminate an amber LED indicator light on the front door of LAP-60011. The maximum fill shall illuminate but shall not activate the LAP-60011 alarm horn and siren. The Maximum Fill Level shall be set-point shall be programmed in PLC-33 and shall be adjustable from OIU-33 and the SCADA HMI.

Overflow Alarm (High-High Level) – shall be provided by each radar level indicating transmitter. LIT-60011 and LIT-60031 shall be equipped with a dry contact relay alarm output that shall activate based on an adjustable level set-point configured locally in each LIT. The relay contact shall be wired to the relay logic in LAP-60011. The set-point shall be configured to be a minimum of 6” below the tank overflow. When triggered the alarm shall be latched on, and the relay logic will illuminate an amber “Overflow Alarm” LED indicator light on the front door. The LAP-60011 alarm horn and flashing light shall be activated. Once the Overflow Alarm condition is no longer present and the “Reset/Silence” pushbutton has been pressed the horn and flashing light shall deactivate and alarm shall be reset. If the Overflow Alarm condition is still active and the reset/silence pushbutton is pressed the horn shall deactivate, but the alarm shall remain latched and flashing light shall remain active.

3.04 ODOR CONTROL SODIUM HYDROXIDE FEED SYSTEM

A. Drawing I-03

B. Control Description

Refer to Section 13253 for requirements.

3.05 ODOR CONTROL SODIUM HYPOCHLORITE FEED SYSTEM

A. Drawing I-03

B. Control Description

Refer to Section 13253 for requirements.

3.06 ODOR CONTROL SCRUBBER SYSTEM

A. Drawing I-3

B. Control Description

Refer to Section 13253 for requirements.

3.07 ADDITIONAL SCADA HMI PROGRAMMING

In addition to the HMI graphics screens described in this Section and indicated on the Drawings, the CONTRACTOR, through the instrumentation and controls subcontractor, shall furnish and install up to two (2) SCADA HMI graphic screens, two (2) unique HMI pop-up notifications, and two (2) unique HMI equipment faceplates at the request of the ENGINEER at no additional cost to the CITY. Additional programming shall include coordination with CITY, ENGINEER and Odor Control Scrubber System supplier.

-END OF SECTION -