

**Solicitation
For Participation in
General Construction Services for Greenland Energy Center Fuel Oil and
Demineralized Water Storage Tank Additions**



Jacksonville, FL

Solicitation Number 125-17

Mandatory Pre-Bid Meeting on August 3, 2017, at 2:00 PM

Greenland Energy Center, 12121 Phillips Highway, Conference Room A,

Jacksonville, FL 32258

Immediately following the Pre-Bid Meeting there will be an optional site walkthrough

**All companies interested in attending the Mandatory Pre-Bid, must contact: Jamila Akrayi at:
akrajr@jea.com a minimum of forty-eight (48) prior to the meeting to be added to the site access list.**

All attendees participating in the Site Visit must bring and wear proper Personal Protective Equipment (PPE) consisting of a hard hat, steel toe shoes and safety eyewear

Bids are due on August 29, 2017 by 12:00 PM

Direct delivery or mail to JEA Bid Office, Customer Center 1st Floor, Room 002

21 W. Church Street, Jacksonville, FL 32202

JEA will publicly open all Bids received from qualified Bidders on August 29, 2017, at

2:00 PM in the JEA Bid Office, Customer Center 1st Floor, Room 002, 21 W. Church Street, Jacksonville, FL

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SOLICITATION

1. SOLICITATION

1.1. INVITATION

1.1.1. SCOPE OF WORK

JEA is soliciting general construction services to support of the installation of three (3) tanks at the JEA Greenland Energy Center, Jacksonville, FL (two [2] fuel oil 500,000 gallon tanks and one [1] demineralized water 800,000 gallon tank).

NOTE: The general construction services in this solicitation are separate services from the actual tank manufacture and installation, which are being procured under a separate solicitation.

The general construction services include, but is not not limited to:

- Earthwork, clearing, grubbing, berm construction and containment
- Tank foundation
- Concrete base construction
- Demolition of existing 20,000 gallon fuel oil storage tank
- Instrumentation
- Lightning protection
- Fire protection
- Finish painting
- Electrical and control wiring.

A detailed scope of work is located in Appendix A - Technical Specifications.

1.1.2. QUESTIONS

All questions must be submitted in writing to the JEA Buyer listed below at least five (5) business days prior to the opening date. Questions received within five (5) business days prior to the opening date will not be answered.

For Procurement Related Questions:

Buyer: RODNEY LOVGREN

E-mail: LOVGRD@JEA.COM

For Technical Questions:

Contact: JAMILA AKRAYI

E-mail: AKRAJR@JEA.COM

1.1.3. INVITATION TO BID

You are invited to bid on the Solicitation noted below:

JEA Solicitation Title: General construction services for Greenland Energy Center fuel oil and demineralized water storage tank additions

JEA Solicitation Number: 125-17

To obtain more information about this Solicitation:

Download a copy of the Solicitation, PDF quality drawings (if applicable) and any required forms at jea.com.

Bid Due Time: 12:00 P.M. - ALL LATE BIDS WILL BE RETURNED UNOPENED

Bid Due Date: August 29, 2017

All Bids must reference the JEA Solicitation title and number noted above. All Bids must be made on the appropriate Bid forms as specified within this Solicitation, and placed in an envelope marked to identify the Solicitation and delivered or mailed to:

JEA Procurement, Bid Office, Customer Center 1st Floor, Room 002, Jacksonville, FL 32202

The Bidder shall be solely responsible for delivery of its Bid to the JEA Bid Office. **Please note, JEA employs a third party courier service to deliver its mail from the local U.S. Postal Service (USPS) which could cause a delay of Bid delivery if mailed through the USPS.** Therefore, JEA recommends direct delivery to the JEA Bid Office. Reliance upon the USPS, the courier service employed by JEA to make pick-ups from the local USPS, or public carriers is at the Bidder's risk.

Bids are due by the time and on the date listed above. ALL LATE BIDS FOR WHATEVER REASON WILL BE RETURNED UNOPENED.

1.1.4. MANDATORY PRE-BID MEETING

There will be a mandatory Pre-Bid meeting. All interested Bidders must attend the Pre-Bid meeting. Each Bidder will be required to sign in at the beginning of the meeting. A Bidder shall only sign in representing one (1) company, unless otherwise specified by JEA. Bidders not attending the Pre-Bid meeting shall have their bids opened, however, the Bid will be rejected and JEA will send the Bidder a disqualification letter.

Bidders shall be on time to the Pre-Bid meeting and Bidders must be present at the starting time of the meeting. Bidders not arriving on time for the meeting will have their Bids rejected and returned unopened.

PLEASE BE AWARE DUE TO JEA SIGN IN AND/OR SECURITY PROCEDURES IT MAY TAKE UP TO FIFTEEN (15) MINUTES TO OBTAIN ACCESS TO A JEA FACILITY. PLEASE PLAN ACCORDINGLY SO AS TO ARRIVE TO THE PRE-BID MEETING ON TIME.

Pre-Bid Meeting Time: 2:00 P.M.

Pre-Bid Meeting Date: August 3, 2017

Pre-Bid Location: 12121 PHILLIPS HWY, CONFERENCE ROOM A, GREENLAND ENERGY CENTER, JACKSONVILLE, FL 32258

1.1.5. OPENING OF BIDS

All Bids shall be publicly opened, read aloud and recorded at 2:00 PM on August 29, 2017 at the JEA Bid Office, 21 W. Church Street, Customer Center 1st Floor, Room 002, Jacksonville, FL 32202.

At the opening of Bids, a JEA Representative will publicly open and announce each Bid that was received on time. Bids that have been properly withdrawn will not be opened. JEA has the right to waive any irregularities or informalities in the Bid Document.

1.2. SPECIAL INSTRUCTIONS

1.2.1. MINIMUM QUALIFICATIONS FOR SUBMISSION

Bidder shall have the following Minimum Qualifications to be considered eligible to submit a Bid in response to this Solicitation. **A Minimum Qualification Form which is required to be submitted with the Bid Form is provided in Appendix B of this Solicitation.**

- The Bidder shall have successfully completed a minimum two (2) similar projects for the general construction services in support storage tank installation in an industrial or utility environment in the past five (5) years, ending in July 31, 2017. A similar project is a general construction project including earthwork, berm spill containment structure, foundations, instrumentation, electrical, lighting, and pipe support valued at greater than \$2,500,000.

It is the responsibility of the Bidder to ensure and certify that it meets the Minimum Qualifications stated below. A Bidder not meeting all of the following criteria will have their Bids rejected:

Please note, any Bidder whose contract with JEA was terminated for default within the last two (2) years shall have their Bid rejected.

1.2.2. EVALUATION METHODOLOGY

1.2.2.1. BASIS OF AWARD - LOWEST BID

JEA will Award this Contract to the responsive and responsible Bidder whose Bid meets or exceeds the Minimum Qualifications set forth in this Solicitation, and the Bidder's price represents the lowest cost to JEA.

JEA will use the Bidder's Total Bid Price stated on the Bid Form when making price comparisons for Award purposes.

1.2.2.2. COMPETITIVE SEALED BIDDING (INVITATION FOR BIDS)

The Bidder shall submit its sealed Bid in response to this Solicitation no later than the Bid due date and time indicated herein. At the public opening of the Bids, the Bids from all Bidders will be publicly announced. After the public opening, JEA will subsequently review Bids to determine if they meet the minimum qualifications as stated in this Solicitation. JEA will Award the Contract to the lowest responsive and responsible Bidder whose Bid meets or exceeds the minimum qualifications, and whose Bid Price represents the lowest cost to JEA.

NO EXCEPTIONS ARE ALLOWED IN AN INVITATION TO BID. IF THE BIDDER OBJECTS IN ANY MANNER TO THE TERMS AND CONDITIONS OR TECHNICAL SPECIFICATIONS, THE OBJECTION MUST BE ADDRESSED IN WRITING FIVE (5) BUSINESS DAYS PRIOR TO THE BID OPENING DATE, AND THE OBJECTION MAY BE ADDRESSED IN AN ADDENDUM IF JEA BELIEVES THAT A CLARIFICATION OR CHANGE IS NECESSARY. ANY MODIFICATIONS, EXCEPTIONS OR OBJECTIONS STATED WITHIN THE BID DOCUMENTS SHALL SUBJECT THE BID TO BE REJECTED.

1.2.3. NUMBER OF CONTRACTS TO BE AWARDED

JEA intends to Award ONE (1) Contract(s) for the Work. JEA reserves the right to Award more than one Contract based on certain groupings of the Work items, or JEA may exclude certain Work items, if JEA determines that it is in its best interest to do so.

1.2.4. JACKSONVILLE SMALL AND EMERGING BUSINESS (JSEB) PROGRAM REQUIREMENTS

1.2.4.1. JACKSONVILLE SMALL AND EMERGING BUSINESS (JSEB) OPTIONAL (IFB)

The specific JSEB participation goal for the Scope of work described in this Solicitation is **TEN PERCENT (10%)**. This percentage is the percentage of the Bidder's total bid price that must be awarded or subcontracted to JSEB firms. Failure to fully comply with the JSEB requirements stated herein may disqualify the Bid.

Bidders are required to complete and submit with their Bid the JSEB form which can be found at www.jea.com. Bidders must specify on the JSEB form how they intend to comply with the JSEB goal stated herein. Bidders that do not submit a JSEB form with their Bid may have their Bids rejected, unless they are exempted under the good faith exception described below.

In no case shall the Bidder make changes to the JSEB firms listed in its Bid, revise the JSEB Scope of work or amount of Work as stated in its Bid without prior written notice to the JEA Contract Administrator, and without subsequent receipt of written approval from the JEA Contract Administrator.

JSEB firms that qualify for this Contract are those shown on the current City of Jacksonville JSEB directory appearing at www.COJ.net. Certification of JSEB firms must come for the City of Jacksonville. No other agency or organization is recognized for purposes of this Contract.

If the Bid does not comply with the JSEB requirements established in this Solicitation, the Bidder must submit documentation as part of its Bid describing in detail its good faith efforts to comply with the JSEB requirements of the Solicitation. This documentation shall include at a minimum the following items:

A written and signed statement describing the level of effort for each of the requirements listed below. Include dates, times, people whom the Bidder contacted and phone numbers to enable JEA to confirm good faith efforts.

Copies of written solicitations of participation the Bidder sent to qualified JSEB firms, showing adequate response time was provided, defining the scope and nature of the work Bidder is asked to perform, Bidder contact information for questions and follow-up, and an offer to meet to review plans, specifications and scope.

A statement of the Bidder's efforts to negotiate a suitable agreement with JSEB firms including call logs showing participants, dates, times, topics discussed, and open issues.

A statement of the Bidder's efforts to help qualified firms that may require assistance in obtaining bonding, insurance, financing, technical support, procedural information, or other items necessary to compete for and perform the Work.

For each offer received from a qualified JSEB firm but rejected by Bidder, a statement explaining why such offer was not made part of the Bid.

For each qualified JSEB firm contacted but considered unqualified by the Bidder to perform a portion of the Work, a statement of the reasons Bidder considered firm to be unqualified.

The Bidder shall contact the JEA JSEB Office for assistance when all independent attempts (emails, phone calls, faxes and letters) to contact qualified JSEB firms have failed, and shall do so in adequate time for JSEB firms to be identified and to allow JSEB firms adequate time in which to respond. Failure by the Bidder to contact the JEA JSEB Office as required herein will be considered when determining if the Bidder has made a good faith effort.

The Bidder understands and agrees that receipt of a lower bid from a non-JSEB qualified firm, will not in and of itself, be sufficient reason to justify failing to meet the JSEB requirements of the Solicitation.

The determination as to whether the Bidder made a good faith effort in trying to achieve the JSEB requirements of this Solicitation will be made solely by JEA and prior to Award.

All questions and correspondence concerning the JSEB program should be addressed to the following contact:

G. Nadine Carswell
JSEB Manager
(904) 665-6257
carsgs@jea.com

1.2.5. INSURANCE REQUIREMENTS

Prior to JEA issuing a Purchase Order to the Bidder to begin the Work or Services, the Bidder shall submit a certificate of insurance (COI) that is in compliance with amounts and requirements as indicated in the Section herein entitled "Insurance Requirements". **Note that the COI shall specifically indicate JEA (and Florida Power and Light Company ("FPL"), if applicable) as additional insured(s) on all required insurance except Worker's Compensation and Professional Liability (if applicable). Furthermore, waiver of subrogation shall be provided for all required insurance in favor of JEA, FPL (if applicable), including their board members, officers, employees, agents, successors, and assigns.**

1.2.6. PAYMENT AND PERFORMANCE BOND REQUIREMENTS

Once the Bidder is Awarded the Contract and upon receipt of the Contract Documents, the Bidder shall furnish a Payment and Performance Bond, or alternate form of security, in the amount indicated on the Bid Form, made out to JEA in forms and formats approved and provided by JEA, as security for the faithful performance of the Work or Services. No modifications to the JEA bond forms are allowed.

A fully executed Payment and Performance Bond must be recorded with the Clerk of Duval County Court and delivered to JEA before the JEA Purchase Order will be issued. JEA will send the approved bond forms to the Bidder for execution along with the Contract; however, in no case shall the date on the bond forms be prior to that of the executed Contract. The surety must be authorized and licensed to transact business in Florida. **Note, that the Bidder is responsible for the costs associated with the required Payment and Performance Bonds; therefore, the costs should be included in the Bidder's total Bid Price.** If the Bidder fails or refuses to furnish or record the required bonds, JEA will retain the Bidder's bid bond as liquidated damages.

To be acceptable to JEA as surety for Performance and Payment Bonds, a surety company shall comply with the following provisions:

- o The Surety Company shall have a currently valid Certificate of Authority, issued by the State of Florida, Department of Insurance, authorizing it to write surety bonds in the State of Florida.
- o The Surety Company shall have a currently valid Certificate of Authority issued by the United States Department of Treasury under Sections 9304 to 9308 of Title 31 of the United States Codes.

- o The Surety Company shall be in full compliance with the provisions of the Florida Insurance Code.
- o The Surety Company shall have at least twice the minimum surplus and capital required by the Florida Insurance Code during the life of this agreement.
- o If the Contract Award Amount exceeds \$500,000, the Surety Company shall also comply with the following provisions:

The Surety Company shall have at least the following minimum ratings in the latest issue of A.M. Best's Key Rating Guide.

POLICY HOLDER'S CONTRACT AMOUNT AND REQUIRED FINANCIAL RATING

\$500,000 TO 1,000,000: A-CLASS IV

\$1,000,000 TO 2,500,000: A-CLASS V

\$2,500,000 TO 5,000,000: A-CLASS VI

\$5,000,000 TO 10,000,000: A-CLASS VII

\$10,000,000 TO 25,000,000: A- CLASS VIII

\$25,000,000 TO 50,000,000: A- CLASS IX

\$50,000,000 TO 75,000,000: A- CLASS X

The Surety Company shall not expose itself to any loss on any one (1) risk in an amount exceeding ten percent (10%) of its surplus to policyholders, provided:

Any risk or portion of any risk being reinsured shall be deducted in determining the limitation of the risk as prescribed in this section. These minimum requirements shall apply to the reinsuring carrier providing authorization or approval by the State of Florida, Department of Insurance, to conduct business in this state has been met.

In the case of the surety insurance company, in addition to the deduction for reinsurance, the amount assumed by any co-surety, the value of any security deposited, pledged or held subject to the consent of the surety and for the protection of the surety shall be deducted.

1.2.7. LIQUIDATED DAMAGES IN CONTRACT

The Contract issued pursuant to this Solicitation contains liquidated damages tied to project completion deadlines. The Bidder should review the specific time frames and liquidated damage amounts prior to submitting its Bid.

1.2.8. SAFETY QUALIFICATION REQUIREMENTS (IFB)

Bidder shall be approved as JEA Safety Qualified within ten (10) business days of receiving written notice from the JEA Bid Office that it is the lowest responsive and responsible Bidder. If the Bidder fails to obtain JEA approval as a JEA Safety Qualified company by 4:00 p.m. Eastern time on the 10th business day, JEA will reject the company's Bid, and proceed to Award to the next lowest responsive and responsible Bidder.

JEA Safety Qualification information is available online at jea.com. Please note that it may take up to five (5) business days for a company to be approved as JEA Safety Qualified. It is the Bidder's responsibility to ensure it is JEA Safety Qualified. A list of the JEA's Safety Qualified vendors can be found on jea.com. For additional information, contact Jerry Fulop at (904) 665-5810.

1.2.9. TIME

In computing any period of time prescribed or allowed by this solicitation, the day of the act, event, or default from which the designated period of time begins to run shall not be included. The last day of the period so computed shall be included unless it is a Saturday, Sunday, or JEA holiday, in which event the period shall run until the end of the next day which is neither a Saturday, Sunday, or JEA holiday.

1.2.10. REQUIRED FORMS TO SUBMIT WITH BID

To submit a Bid in response to this Solicitation, all of the forms listed below must be completed and submitted as part of the Bid. The Bidder must obtain the required forms, other than the forms provided in the solicitation, by downloading them from JEA.com. If the Bidder fails to complete or fails to submit one (1) or more of the required forms, the Bid shall be rejected.

The following forms are required to be submitted at the time of Bid:

- o Bid Bond
- o Bid Form (including acknowledgements of all addenda) - This form can be found in Appendix B
- o Minimum Qualifications Form - This form can be found in Appendix B
- o List of JSEB Certified Firms
- o Florida Trench Safety Act Acknowledgment
- o Construction and Demolition Debris Disposal (if applicable)
- o State of Florida General Contractors license number- entered on the Appendix B Bid Form
- o Subcontractor Form

If the above listed forms are not submitted with the Bid by the Bid Due Time on the Bid Due Date, JEA shall reject the Bid.

JEA also requires the following documents to be submitted prior to execution of Contract. A Bid will not be rejected if these forms are not submitted at the Bid Due Time and Date. However, failure to submit these documents at the time of Contract execution could result in Bid rejection.

- o Conflict of Interest Certificate Form
- o Insurance Certificate
- o W-9
- o Evidence of active registration with the State of Florida Division of Corporations (www.sunbiz.org)
- o Any technical submittals as required by the Technical Specifications.

1.2.11. BID SECURITY/BID BOND

All Bids shall be accompanied by a bid security in the amount stated on the Bid Form. The bid security must be furnished by the Bidder at or before the opening of Bids. The bid security shall either be issued by a surety company authorized to do business in the State of Florida, or Bidder shall furnish a certified check or cashier's check in the amount of FIVE percent (5%) of the total Bid Amount shown on the Bid Form. The JEA Bid Bond form can be found at jea.com. Failure to furnish the required bid security will disqualify the Bid. If the Bidder is Awarded the Work and fails to execute the Contract within ten (10) days of postmarked date on the Contract Documents, JEA shall retain the Bid Bond or check as liquidated damages.

1.3. GENERAL INSTRUCTIONS

1.3.1. COMPLETING THE BID DOCUMENTS

Bidders shall complete and submit all Bid Documents with responses typewritten or written in ink. ALL BIDS SUBMITTED LATE TO THE JEA BID OFFICE WILL BE REJECTED.

When a blank is marked "optional" on the bid form, the Bidder shall insert the words "No Bid" in the space provided if the Bidder does not choose to submit a price for that item. Failure to complete each blank with either a price or the words "No Bid" may disqualify the Bid. The Bidder, or its authorized agent or officer, shall sign the Bid Documents.

Failure to sign the Bid Documents may disqualify the Bid. JEA approved erasures, interlineations or other corrections shall be authenticated by affixing in the margin, immediately opposite the correction, the handwritten signature of each person executing the Bid. Failure to authenticate changes may disqualify the Bid. JEA may disqualify any Bids that deviate from the requirements of this Solicitation, and those that include unapproved exceptions, amendments, or erasures.

1.3.2. CALCULATION OF THE BID PRICE

JEA will use the Bidder's Total Bid Price stated on the Bid Form when making price comparisons for Award purposes.

1.3.3. SUBMITTING THE BID FORM

The Bidder shall submit one (1) original of all the Bid Documents, two (2) duplicates and one (1) CD or thumb drive of the original Bid Documents. It is encouraged that all submitters include an electronic version with their hardcopy submittal.

JEA will not accept Bid Documents files transmitted via email. If electronic copies of the Bid Documents are submitted, they must be submitted on a CD with the hardcopies of the Bid Documents.

1.3.4. MODIFICATION OR WITHDRAWAL OF BIDS

The Bidder may modify or withdraw its Bid at any time prior to the Bid Due Date and Time by giving written notice to JEA's Chief Procurement Officer. JEA will not accept modifications submitted by telephone, telegraph, email, or facsimile, or those submitted after the Bid Due Date and Time. The Bidder shall not modify or withdraw its Bid from time of Bid opening and for a period of ninety (90) days following the opening of Bids.

1.3.5. ADDENDA

JEA may issue Addenda prior to the Bid opening date to revise, in whole or in part, or clarify the intent or requirements of the Solicitation. The Bidder shall be responsible for ensuring it has received all Addenda prior to submitting its Bid and shall acknowledge receipt of all Addenda by indicating where requested on the Bid Form. JEA will post all Addenda when issued online at jea.com. The Bidder must obtain Addenda from the JEA website. All Addenda will become part of the Solicitation and any resulting Contract Documents. It is the responsibility of each Bidder to ensure it has received and incorporated all Addenda into its Bid. Failure to acknowledge receipt of Addenda may be grounds for rejection of a Bid.

1.3.6. CONTRACT EXECUTION AND START OF WORK

Within thirty (30) days from the date of Award, JEA will present the successful Bidder with the Contract Documents. Unless expressly waived by JEA, the successful Bidder shall execute a Contract for the Work or Services within ten (10) days after receiving the Contract from JEA. If the Bidder fails to execute the Contract or associated documents as required, or if it fails to act on a JEA-issued Purchase Order (PO), JEA may cancel the Award with no further liability to the Bidder, retain the bid security or bond (if applicable), and Award to the next-ranked company.

Upon JEA's receipt of the executed Contract, certificate of insurance, and recorded Payment and Performance bonds (if applicable), JEA will issue a PO, in writing and signed by an authorized JEA representative as acceptance of the Proposal or Bid and authorization for the company to proceed with the Work, unless otherwise stated in the Contract or PO.

For Construction Services: In the event that JEA intends to authorize the successful Bidder to proceed with administrative work only, or with only a portion of the Work, then the PO shall state the specific limitations of such

authorization and JEA will issue a separate written Notice to Proceed to authorize the Bidder to begin Field Work, when applicable, or to perform the remainder of the Work, or any portion thereof. The Bidder shall ensure that it is prepared to begin Field Work upon receipt of Notice to Proceed. Any Work performed outside of this partial authorization shall be at the Bidder's risk and JEA shall have no obligation to pay for such Work.

1.3.7. DEFINED TERMS

Words and terms defined in the Section entitled "Definitions" of this document are hereby incorporated by reference into the entire document.

1.3.8. EX PARTE COMMUNICATION

Ex Parte Communication is strictly prohibited. Ex Parte Communication is defined as any inappropriate communication concerning a Solicitation between a firm submitting a Bid and a JEA representative during the time in which the Solicitation is being advertised through the time of Award. Examples of inappropriate communications include: private communications concerning the details of Solicitation in which a Bidder becomes privy to information not available to the other Bidders. Social contact between Bidders and JEA representatives should be kept to an absolute minimum during the solicitation process.

Failure to adhere to this policy will disqualify the noncompliant Company's Bid. Any questions or clarifications concerning a Solicitation must be sent in writing via email to the JEA Buyer at least five (5) business days prior to the opening date. If determined by JEA, that a question should be answered or an issue clarified, JEA will issue an addendum to all Bidders.

For more information on Ex Parte communications, see JEA Procurement Code, Article 1-110, which is available at www.jea.com.

1.3.9. JEA PUBLICATIONS

Applicable JEA publications are available at jea.com.

1.3.10. PROHIBITION AGAINST CONTINGENT FEES

The Company warrants that it has not employed or retained any company or person, other than a bona fide employee working for the Company, or an independent sales representative under contract to the Company, to solicit or secure a contract with JEA, and that it has not paid or agreed to pay any person, company, corporation, individual or Company, other than a bona fide employee working solely for the Company, or an independent sales representative under contract to the Company, any fee, commission, percentage, gift, or any other consideration, contingent upon or resulting from the Award or making of the Contract. For a breach or violation of these provisions occurs, JEA shall have the right to terminate the Contract without liability, and at its discretion, to deduct from the Contract Price, or otherwise recover, the full amount of such fee, commission, percentage, gift or consideration.

1.3.11. RESERVATIONS OF RIGHTS TO JEA

The Solicitation provides potential Companies with information to enable the submission of written offers. The Solicitation is not a contractual offer or commitment by JEA to purchase products or services.

Bids shall be good for a period of ninety (90) days following the opening of the Bids.

JEA reserves the right to reject any or all Bids, or any part thereof, and/or to waive informalities if such action is in its best interest. JEA may reject any Bids that it deems incomplete, obscure or irregular including, but not limited to, Bids that omit a price on any one (1) or more items for which prices are required, Bids that omit Unit Prices if Unit Prices are required, Bids for which JEA determines that the Bid is unbalanced, Bids that offer equal items when the

option to do so has not been stated, Bids that fail to include a Bid Bond, where one is required, and Bids from Companies who have previously failed to satisfactorily complete JEA contracts of any nature or who have been scored by JEA as "Unacceptable" and as a result, are temporarily barred from bidding additional work.

JEA reserves the right to cancel, postpone, modify, reissue and amend this Solicitation at its discretion.

JEA reserves the right to cancel or change the date and time announced for opening of Bids at any time prior to the time announced for the opening of Bids. JEA may Award the Contract in whole or in part. In such cases whenever JEA exercises any of these reservations, JEA will make a commercially reasonable effort to notify, in writing, all parties to whom Solicitations were issued. JEA may award multiple or split Contracts if it is deemed to be in JEA's best interest.

1.3.12. SUNSHINE LAW

General

Article I, Section 24, Florida Constitution, guarantees every person access to all public records and Chapter 119, Florida Statutes, provide a broad definition of public records. JEA is a body politic and corporate and subject to these laws and related statutes ("Florida's Public Records Laws"). All responses to this Solicitation are public records and available for public inspection unless specifically exempt by law.

IF A BIDDER HAS QUESTIONS REGARDING THE APPLICATION OF CHAPTER 119, FLORIDA STATUTES, TO THE CONTRACTOR'S DUTY TO PROVIDE PUBLIC RECORDS RELATING TO THIS CONTRACT, CONTACT THE CUSTODIAN OF PUBLIC RECORDS AT:

JEA

Attn: Public Records

21 West Church Street

Jacksonville, Florida 32202

Ph: 904-665-8606

publicrecords@jea.com

Redacted Submissions

If a Bidder believes that any portion of the documents, data or records submitted in response to this Solicitation are exempt from Florida's Public Records Law, Bidder must (1) clearly segregate and mark the specific sections of the document, data or records as "Confidential," (2) cite the specific Florida Statute or other legal authority for the asserted exemption, and (3) provide JEA with a separate redacted copy of its response (the "Redacted Copy"). The cover of the Redacted Copy shall contain JEA's title and number for this Solicitation and Bidder's name, and shall be clearly titled "Redacted Copy." Bidder should only redact those portions of records that Bidder claims are specifically exempt from disclosure under Florida's Public Records Laws. If Bidder fails to submit a redacted copy of information it claims is confidential, JEA is authorized to produce all documents, data and other records submitted to JEA in answer to a public records request for such information.

In the event of a request for public records to which documents that are marked as confidential are responsive, JEA will provide the Redacted Copy to the requestor. If a requestor asserts a right to any redacted information, JEA will notify Bidder that such an assertion has been made. It is Bidder's responsibility to respond to the requestor to assert

that the information in question is exempt from disclosure under applicable law. If JEA becomes subject to a demand for discovery or disclosure of Bidder's redacted information under legal process, JEA shall give Bidder prompt notice of the demand prior to releasing the information (unless otherwise prohibited by applicable law.) Bidder shall be responsible for defending its determination that the redacted portions of its response are not subject to disclosure.

By submitting a response to this Solicitation, Bidder agrees to protect, defend and indemnify JEA from and against all claims, demands, actions, suits, damages, liabilities, losses, settlements, costs and expenses (including but not limited to reasonable attorney fees and costs) arising from or relating to Bidder's determination that the redacted portions of its response to this Solicitation are not subject to disclosure.

1.3.13. ESTIMATED QUANTITIES

On the Bid Document, JEA sets forth anticipated quantities, or estimates of anticipated purchase volumes by JEA. JEA anticipates that these quantities are reasonable and will not be exceeded. During the Bid process, if the Bidder finds any discrepancy greater than ten percent (10%) of the estimated quantity, the Bidder shall notify the JEA Representative in writing of the discrepancy. JEA will check the estimated quantity and if it is found to exceed ten percent (10%) of the estimated quantity, JEA will issue an Addendum to all Bidders.

After Award of the Contract, JEA will make payments upon the actual quantities of Work provided and JEA shall not be obligated, in any way, to pay any amounts for quantities other than those actually provided and authorized under this Contract, regardless of amount stated in the Solicitation. In the event that quantities or scope of work change after Award, the changes to price and/or scope shall be made in accordance with the terms and conditions stated in the Contract Document.

Any item not shown on the Bid Document, but shown in the drawings or Technical Specifications section, that is required to perform the Work, or that is required as part of a complete and operable system, shall be included in the Bid Price.

1.3.14. ETHICS (IFB)

By signing the Bid Form, the Bidder certifies this Bid is made without any previous understanding, agreement or connection with any other person, firm, or corporation submitting a Bid for the same Work other than as a Subcontractor or supplier, and that this Bid is made without outside control, collusion, fraud, or other illegal or unethical actions. The Bidder shall comply with all JEA and City of Jacksonville ordinances, policies and procedures regarding business ethics.

The Bidder shall submit only one (1) Bid in response to this Solicitation. If JEA has reasonable cause to believe the Bidder has submitted more than one (1) Bid for the same Work, other than as a Subcontractor or subsupplier, JEA shall disqualify the Bid and may pursue debarment actions.

The Bidder shall disclose the name(s) of any public officials who have any financial position, directly or indirectly, with this Bid by completing and submitting the Conflict of Interest Certificate Form available at jea.com. If JEA has reason to believe that collusion exists among the Bidders, JEA shall reject any and all Bids from the suspected Bidders and will proceed to debar Bidder from future JEA Awards in accordance with the JEA Purchasing Code.

JEA is prohibited by its Charter from awarding contracts to JEA officers or employees, or in which a JEA officer or employee has a financial interest. JEA shall reject any and all Bids from JEA officers or employees, as well as, any and all Bids in which a JEA officer or employee has a financial interest.

In accordance with Florida Statutes Sec. 287.133, JEA shall reject Bids from any persons or affiliates convicted of a public entity crime as listed on the Convicted Vendor list maintained by the Florida Department of Management Services. JEA shall not make an Award to any officer, director, executive, partner, shareholder, employee, member, or agent active in management of the Bidder listed on the Convicted Vendor list for any transaction exceeding \$35,000.00 for a period of thirty-six (36) months from the date of being placed on the Convicted Vendor list.

If the Bidder violates any requirement of this clause, the Bid may be rejected and JEA may debar offending companies and persons.

1.3.15. FLORIDA TRENCH SAFETY ACT

If required, the Bidder shall complete and submit with its Bid the Florida Trench Safety Act Acknowledgment form, in accordance with Florida Statutes when the Work includes trench excavations that exceed five (5) feet in depth and as written assurance that the Bidder shall comply with all applicable trench safety standards, laws, rules and regulations during performance of any Work awarded from this Solicitation.

1.3.16. MATHEMATICAL ERRORS

In the event of a mathematical error in calculation of the prices entered on the Bid Form, the Unit Prices will prevail. The corrected Bid Price utilizing the Unit Prices will be used to determine if the Company is Awarded the Work or the Services. Subsequently, the Unit Prices will be used throughout the term of the Contract.

1.3.17. AVAILABILITY OF BIDS AFTER BID OPENING

In accordance with the Florida Public Records Law, Florida Statutes, Chapter 119, copies of all Bids are available for public inspection thirty (30) days after the opening of Bids or on the date of Award announcement, whichever is earlier. Bidders may review opened Bids once they are available for public inspection by contacting the designated Buyer or JEA's Public Records custodian whose contact information can be found at jea.com. JEA will post a summary of the Bid results immediately after the Bid opening.

1.3.18. PROTEST OF BIDDING AND AWARD PROCESS

Companies shall file any protests regarding this Solicitation in writing, in accordance with the JEA Purchasing Code, as amended from time to time. The JEA Purchasing Code is available online at jea.com.

1.3.19. SHIPPING, FREIGHT, AND TRAVEL--F.O.B. DESTINATION

The Bidder shall include the price for travel, shipment of materials and equipment in its pricing shown on the Bid Form or Bid Workbook unless otherwise stated herein. The shipment of all materials shall be F.O.B. Destination.

If the Solicitation allows for travel expenses to be billed separately, then all Bidder's travel expenses will be reimbursed in accordance with JEA's Contractor Travel Policy.

1.3.20. LISTING OF SUBCONTRACTORS

JEA shall specify the major Subcontractors that the Company must list is the Company intends to use a Subcontractor to perform a portion of the Work, unless the Work will be self-performed by the Company. The Subcontractors that JEA requires to be listed is stated in the Section titled "Required Forms to Be Submitted with the Bid". The major Subcontractors shall be listed on the Subcontractors Form which is available at jea.com. Failure of the Company to submit the required Subcontractor information on the form with its Bid shall result in rejection of the Company's Bid.

The Company shall not use Subcontractors and subsuppliers/shop fabricators other than those shown on the Subcontractor Form unless it shows good cause and obtains the JEA Representative's prior written consent. If the Company plans to use Subcontractors or subsupplier/shop fabricators to perform over fifty percent (50%) of the Work, the Company shall obtain JEA's approval at least five (5) days prior to the Bid Due Date. Failure to obtain JEA approval will disqualify the Company and result in rejection of Company's Bid.

1.3.21. CERTIFICATION AND REPRESENTATIONS OF THE BIDDER

By signing and submitting a Bid, the Bidder certifies and represents as follows:

- A. That it has carefully examined all available records and conditions, including sites if applicable, and the requirements and specifications of this Solicitation prior to submitting its Bid. Where the Bidder visits sites, no Work or other disturbance is to be performed while at the site without written permission by JEA in advance of the site visit. The Bidder shall comply with all safety requirements described in the Solicitation and shall be prepared to show proof of insurance
- B. That every aspect of its submitted Bid, including the Bid Price and the detailed schedule for the execution of the Work, are based on its own knowledge and judgment of the conditions and hazards involved, and not upon any representation of JEA. JEA assumes no responsibility for any understanding or representation made by any of its representatives during or prior to execution of the Contract unless such understandings or representations are expressly stated in the Contract and the Contract expressly provides that JEA assumes the responsibility.
- C. That the individual signing the Bid Documents is a duly authorized agent or officer of the firm. Bids submitted by a corporation must be executed in the corporate name by the President or Vice President. If an individual other than the President or Vice President signs the bid, satisfactory evidence of authority to sign may be requested by JEA. If the Bid is submitted by a partnership, the bid must be signed by a partner whose title must appear under the signature. If an individual other than a partner signs the bid, satisfactory evidence of authority to sign may be requested by JEA. The corporation or partnership must be in active status at the Florida Division of Corporations at the time of contract execution.
- D. That the firm maintains an active status any and all licenses, permits, certifications, insurance, bonds and other credentials including, but not limited to, contractor's license and occupational licenses necessary to perform the Work. The Bidder also certifies that, upon the prospect of any change in the status of applicable licenses, permits, certifications, insurances, bonds or other credentials, the Bidder shall immediately notify JEA of status change.
- E. That Bidder has read, understands these instructions and will comply with the Section titled Ethics.

1.3.22. CONFLICT OF INTEREST (CONSTRUCTION)

This conflict of interest policy applies to all JEA construction projects ("Project"). Any company bidding the construction phase of a Project cannot at the time of Bid submittal, be affiliated with or have any direct or indirect ownership interest in the architect/engineer ("Designer") of record. The company will also be prohibited from bidding if the Designer has any direct or indirect ownership interest in the Contractor. Should JEA erroneously award a contract in violation of this policy, JEA may terminate the contract at any time with no liability to company, and company shall be liable to JEA for all damages, including but not limited to the costs to rebid the Project. The

purpose of this policy is to encourage bidding and eliminate any actual or perceived advantage that one (1) Bidder may have over another.

1.3.23. CONSTRUCTION AND DEMOLITION DEBRIS

The Bidder shall complete and submit the Construction and Demolition Debris Disposal form which is available at www.jea.com. The Bidder shall identify, by the Certificate of Necessity number and Public Works number, the sites to which it will remove for disposal debris resulting from the Work. A list of approved sites may be obtained from the JEA Office Section or jea.com.

1.3.24. UNABLE TO SUBMIT BID FORMS

If you elect not to submit a Bid in response to this Solicitation, please complete the Unable to Submit Bid Form, available for download at www.jea.com, or by obtaining a hardcopy from the JEA Bid Office, 21 West Church St., Customer Center 1st Floor, Room 002, Jacksonville, FL 32202. The Bidder may contact the Bid Office by phone at (904) 665-6740.

Send the completed Unable to Submit Bid Form to:

JEA Bid Office
21 West Church St., CC-1, Room 002
Jacksonville, FL 32202

or fax the Unable to Submit Bid Form to: (904) 665-7095.

Do not return the entire Solicitation package; simply return the Unable to Submit Bid Form.

2. CONTRACT TERMS AND CONDITIONS

2.1. CONTRACT DOCUMENT AND TERMS AND CONDITIONS

Provided below are the Contract terms and conditions that will be incorporated by reference in the Contract Document executed by the Company and JEA. The Contract Document will incorporate by reference the terms contained in the Solicitation portion of this document provided in Section 1, the Contract Terms provided in Section 2; and the Technical Specifications provided in Section 3. An example of the Contract that the Company will be required to execute is available for review at jea.com.

2.2. DEFINITIONS

2.2.1. DEFINITIONS

Words and terms defined in this section shall have the same meaning throughout all parts of this Solicitation and Contract Documents. Where intended to convey the meaning consistent with that set forth in its definition, a defined word or term is marked by initial capitalization. The "Technical Specifications" portion of this Solicitation may define additional words and terms where necessary to clarify the Work. Unless otherwise stated in this Solicitation and/or Contract Documents, definitions set forth in the "Technical Specifications" shall apply only within the "Technical Specifications."

2.2.2. ACCEPTANCE

JEA's written notice by the Contract Administrator to the Company that all Work as specified in the Contract, or a portion of the Work as specified in a Task or Work Order, has been completed to JEA's satisfaction. Approval or recognition of the Company meeting a Milestone or interim step does not constitute Acceptance of that portion of

Work. Acceptance does not in any way limit JEA's rights under the Contract or applicable laws, rules and regulations.

2.2.3. ADDENDUM/ADDENDA

A written change or changes to the Solicitation which is issued by JEA Procurement Services and is incorporated into the Solicitation as a modification, revision and/or further clarification of the intent of the Solicitation.

2.2.4. ADMINISTRATIVE WORK

Actions primarily performed in an office environment and associated with preparing to perform or administer the Work including, but not limited to, preparing Work schedules, obtaining bonds, executing Contracts, securing resources and other actions specified in the Solicitation, or otherwise prudent to ensure a timely, safe and otherwise compliant start and performance of Field Work. Administrative Work is not performed at the Work Location.

2.2.5. ANNIVERSARY DATE

The date which is twelve (12) months after the effective date of the Contract, and each date which is twelve (12) months after an Anniversary Date that occurs while the Contract is in effect.

2.2.6. APPLICATION FOR PAYMENT

The form required for payment which shall include all items required pursuant to the contract for the payment to be processed by JEA. Such form shall require the Contractor expressly state that the Contractor has fulfilled all obligations for the previous payments issued to the Contractor, including payment for subcontractors and materials. The Application for Payment includes all forms and supporting documentation as required by the Contract documents.

2.2.7. APPROVED SCHEDULE

A Critical Path Method Schedule or a Summary Schedule for the Work approved in writing by the Contract Administrator.

2.2.8. AWARD

The written approval of the JEA Awards Committee that the procurement process for the purchase of the Work was in accordance with the JEA Procurement Code and Florida Statutes. Once an Award is approved, JEA will either issue a Purchase Order or execute a Contract with the successful bidder or proposer.

2.2.9. BID DOCUMENTS

The forms required to be submitted to JEA as the Company's offer to perform the Work or Services described herein. The Bid Documents can include, but is not limited to, the Bid Form, Bid Workbook, Minimum Qualifications Form, certifications and/or other required submittals. The Bid Documents may also be referred to as the "Bid Form".

2.2.10. BID OR PROPOSAL

The document describing the Bidder's offer submitted in response to this Solicitation. Bid and Proposal shall be considered synonymous for the purpose of this Contract.

2.2.11. BID PRICE

The total dollar amount of the Bidder's offer to successfully perform the Work or Services in accordance with the Contract Documents.

2.2.12. BIDDER OR PROPOSER

The respondent to this Solicitation. Bidder and Proposer shall be considered synonymous for the purpose of this Solicitation.

2.2.13. CHANGE ORDER

A written order issued after execution of the Contract to the Company signed by the Contract Administrator, or his designated representative, authorizing an addition, deletion, or revision of the Work, or an adjustment in the Contract Price or the Contract Time. Change Orders do not authorize expenditures greater than the monies encumbered by JEA, which is shown on the associated Purchase Order(s). An executed Change Order resolves all issues related to price and time for the Work included in the Change Order. A Change Order that involves a material change to the Contract may result in a Contract Amendment.

2.2.14. COMPANY

The legal person, firm, corporation or any other entity or business relationship with whom JEA has executed the Contract. Where the word "Company" is used it shall also include permitted assigns. Prime Contractor, Contractor, Vendor, Supplier and Company shall be considered synonymous for the purpose of the Contract.

2.2.15. COMPANY REPRESENTATIVE

The individual responsible for representing the Company in all activities concerning the fulfillment and administration of the Contract.

2.2.16. COMPANY SUPERVISOR

The individual, employed or contracted by the Company, to manage the Work on a day-to-day basis and ensure the Work is performed according to the Contract. The Company Supervisor may be authorized by the Company Representative to act on Contract matters. Such authorization shall be in writing and delivered to the Contract Administrator and shall clearly state the limitations of any such authorization. In the event that the Company Supervisor and the Company Representative is the same person, the Company shall notify the Contract Administrator of such situation.

2.2.17. CONTRACT

An agreement between JEA and the Company, signed by both parties, which incorporates all the Contract Documents. The Contract shall not be altered without an Amendment to the Contract and executed by JEA and the Company, or a JEA issued Change Order.

2.2.18. CONTRACT ADMINISTRATOR

The individual assigned by JEA to have authority to administer the Contract, including the authority to negotiate all elements of the Contract with the Company, authorize Change Orders within the maximum amount awarded, terminate the Contract, seek remedies for nonperformance including termination, and otherwise act on behalf of JEA in all matters regarding the Contract. The Contract Administrator may authorize JEA Representative in writing to make minor changes to the Work with the intent of preventing Work disruption.

2.2.19. CONTRACT DOCUMENTS

Contract Documents, also referred to as the "Contract" means the executed Contract, all Solicitation documents and Bid Documents as further described in the Section of the Solicitation titled "Contract Documents", and any written Change Orders, amendments or Purchase Orders executed by JEA, and insurance and/or bonds as required by the Contract.

2.2.20. CONTRACT PRICE

The total amount payable to the Company during the initial Term of the Contract. However, this amount is not a guaranteed amount. Also referred to as the "Maximum Indebtedness" of JEA.

2.2.21. CONTRACT TIME (CONSTRUCTION)

The number of calendar days or the period of time from when the written Purchase Order is issued to the Company to Substantial Completion and Acceptance of the Work.

2.2.22. CONTRACTOR

The legal person, firm, corporation or any other entity or business relationship with whom JEA has executed the Contract. Where the word "Contractor" is used it shall also include permitted assigns. Contractor and Company shall be considered synonymous for the purpose of the Contract.

2.2.23. CRITICAL PATH METHOD (CPM) SCHEDULE

A schematic display of the sequential and logical relationship of all activities that comprise the Work. Using a combination of duration, early and late start dates, and early and late finish dates, a critical path is established as the path of interdependent activities that must be sequentially performed and that require a longer total time to perform than any other such series. CPM Schedules suitable for use on this Contract use GANNT Precedence formats.

2.2.24. CUSTOMER SERVICE PLAN

The Company's plan to achieve customer satisfaction requirements as determined by JEA and JEA Project Outreach, which shall include, as a minimum, the name and office phone number, cell phone number, email address, Nextel Direct Connect number, and fax number of Company's Customer Service Representative, a detailed flow chart on how the Company will handle customer concerns, preemptive customer satisfaction control measures (such as door hangers provided by JEA, and neighborhood meetings in conjunction with JEA staff) and a plan to reduce the number of customer concerns surrounding construction Work addressing, as a minimum, the construction practices that will eliminate damage to customers' property including, but not limited to, cracked driveways, tire ruts in customers' yards, blocking customers' access to driveways, cutting customers' services during tie-in, excessive noise from construction equipment, and elimination of dust during construction Work.

2.2.25. DEFECT

Work that fails to reach Acceptance, or Work that fails meet the requirements of any required test, inspection or approval, and any Work that meets the requirements of any test or approval, but nevertheless does not meet the requirements of the Contract Documents.

2.2.26. ENVIRONMENTAL REGULATIONS

All laws, ordinances, statutes, codes, rules, regulations, agreements, judgments, orders, and decrees, now or hereafter enacted, promulgated, or amended, of the United States, the states, the counties, the cities, or any other political subdivisions in which the Work Location is located, and any other political subdivision, agency or instrumentality exercising jurisdiction over JEA, the Work Location, or the use of the Work Location, relating to pollution, the protection or regulation of human health, natural resources, or the environment, or the emission, discharge, release or threatened release of pollutants, contaminants, chemicals, or industrial, toxic or hazardous substances or waste or Hazardous Materials (as defined in this Contract) into the environment (including, without limitation, ambient air, surface water, ground water or land or soil).

2.2.27. EQUAL ITEM

Item a Bidder chooses to offer in place of offering the brand name or manufacturer's item specified on the Bid Document when the Bid Document clearly states that the Bidder may offer such an item.

2.2.28. FIELD WORK

Actions associated with meeting the requirements of the Contract other than Administrative Work. Field Work is primarily performed at the Work Location.

2.2.29. FINAL COMPLETION

The point in time after JEA makes the determination that the Work is completed and there is Acceptance by JEA, and the Company has fulfilled all requirements of the Contract Documents.

2.2.30. FINAL PAYMENT

The Final Payment for all Work performed. Final Payment shall not be made until the Company has complied with all the Contract requirements, and provided as necessary close-out documents as contained in the Contract.

2.2.31. HAZARDOUS MATERIALS

Any substance which is or contains (i) any "hazardous substance" as now or hereafter defined in the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended (42 U.S.C. '9601 et seq.) ("CERCLA") or any regulations promulgated under or pursuant to CERCLA; (ii) any "hazardous waste" as now or hereafter defined in the Resource Conservation and Recovery Act (42 U.S.C. '6901 et. seq.) ("RCRA") or regulations promulgated under or pursuant to RCRA; (iii) any substance regulated by the Toxic Substances Control Act (15 U.S.C. '2601 et seq.); (iv) gasoline, diesel fuel, or other petroleum hydrocarbons; (v) asbestos and asbestos containing materials, in any form, whether friable or non-friable; (vi) polychlorinated biphenyls; (vii) radon gas; and (viii) any additional substances or materials which are now or hereafter classified or considered to be hazardous or toxic under Environmental Requirements (as hereinafter defined) or the common law, or any other applicable laws relating to the Licensed Property. Hazardous Materials shall include, without limitation, any substance, the presence of which on the Licensed Property, (A) requires reporting, investigation or remediation under Environmental Requirements; (B) causes or threatens to cause a nuisance on the Licensed Property or adjacent property or poses or threatens to pose a hazard to the health or safety of persons on the Licensed Property or adjacent property; or (C) which, if it emanated or migrated from the Licensed Property, could constitute a trespass.

2.2.32. HOLIDAYS

The following days: New Year's Day, Martin Luther King Jr. Day, Presidents' Day, Memorial Day, Independence Day, Labor Day, Veterans Day, Thanksgiving Day, Day after Thanksgiving, Christmas Eve Day, and Christmas Day.

2.2.33. INVOICE

A document seeking payment to Company from JEA for all or a portion of the Work, in accordance with the Contract Documents, and including at a minimum the following items: the Company's name and address, a description of the product(s) or service(s) rendered, a valid JEA PO number, the amount payable, the Unit Price, the payee name and address, any associated JSEB forms and any other supporting documentation required by the Contract Documents.

2.2.34. JEA

JEA on its own behalf, and when the Work involves St. Johns River Power Park (SJRPP), as agent for Florida Power and Light Company (FPL). JEA and FPL are co-owners of SJRPP.

2.2.35. JEA ENGINEER

The individual assigned by JEA (either an employee or a third party) to provide licensing, engineering, design review, and/or construction management including, but not limited to, overseeing and resolving engineering/design issues, conveying JEA's instructions to the Company and enforcing the faithful performance of the Work. The JEA Engineer's authority includes interpreting the technical portion of the Contract Documents, deciding on matters relating to the execution and progress of the Work and evaluating the Company's performance. The JEA Engineer may stop the Work when deemed necessary by JEA. The JEA Engineer will receive and adjudicate any claim of ambiguity or error in the technical portion of the Contract Documents and shall reduce any determination to writing, and the decision shall be final and binding. The JEA Engineer is not a party to the Contract. The JEA Engineer has no authority to approve changes to the Work or Contract, or to commit JEA to any expenditure of money except as expressly designated in writing by the Contract Administrator.

2.2.36. JEA INSPECTOR

The individual(s) or company(ies) designated by the Contract Administrator to inspect and test the Company's performance and Contract compliance including materials, workmanship, safety, environmental compliance, JSEB compliance, project controls, administration and accounting, and other aspects of Contract compliance. The JEA Inspector has no authority to approve changes to the Work or Contract, or to commit JEA to any expenditure of money except as expressly designated in writing by the Contract Administrator.

2.2.37. JEA REPRESENTATIVES

The Contract Administrator, Contract Inspector, Contract Administrator's Representative, JEA Engineer, Field Engineer, Project Manager, and other persons designated by the Contract Administrator as JEA Representatives acting in a capacity related to the Work or Contract under the authority of the Contract Administrator.

2.2.38. LUMP SUM BULK BID PRICE

The total amount payable to the Company under the Contract Documents for performing the bulk bid Work.

2.2.39. MILESTONE

A point in time representing a key or important intermediate event in the Work. A Milestone is to be capable of validation by meeting all of the items prescribed in a defining checklist as agreed to in writing by JEA.

2.2.40. NOTICE TO PROCEED

The written notice, duly authorized and delivered by JEA, that authorizes the Company to begin the Work. The Notice to Proceed is normally issued in the form of a Purchase Order, unless otherwise specified in the Contract Documents.

2.2.41. OVERTIME

Work approved in writing by the Contract Administrator that is required to be performed beyond an employee's scheduled workday or work week, including Work performed on Holidays.

2.2.42. PAYMENT AND PERFORMANCE BONDS

The common-law Performance Bond and the statutory Payment Bond contemplated by Section 255.05, Florida Statutes in the form required by JEA.

2.2.43. PRE-WORK MEETING

A meeting conducted after Award and prior to the start of any Field Work between JEA and the Company. The purpose of the meeting may include, but is not limited to orientation, schedule, certification and permitting, and other preparatory or Work execution details.

2.2.44. PERFORMANCE - ACCEPTABLE PERFORMANCE/PERFORMER

The Company averages more than 2.80 and less than 4.0 across all performance scorecard evaluation metrics, and does not receive a score of less than 2.0 on any metric.

2.2.45. PERFORMANCE - TOP PERFORMANCE/PERFORMER

The Company averages 4.0 or more across all scorecard evaluation metrics and does not receive a score of less than 4.0 on any one (1) metric.

2.2.46. PERFORMANCE - UNACCEPTABLE PERFORMANCE/PERFORMER

The Company averages less than 2.80 across all scorecard evaluation metrics, or scores a 1.0 on any one (1) metric regardless of average, or receives a score of 2.0 on the same metric on two (2) sequential performance evaluations.

2.2.47. PURCHASE ORDER (PO)

A commercial document issued by JEA, authorizing work, indicating types, quantities, and agreed prices for products or services the Company will provide to JEA. Sending a PO to a Company constitutes a legal offer to buy products or services. The words "Purchase Order" are clearly marked across the top, a PO number is used for reference and invoicing purposes, includes an authorized JEA signature, and states the dollar amount of the lawfully appropriated funds.

2.2.48. QUALITY ASSURANCE

Actions that JEA takes to assess the Company's performance under the Contract.

2.2.49. QUALITY CONTROL

Actions that the Company takes to ensure it successfully completes the Work in full accordance with the Contract Documents.

2.2.50. SCHEDULE

All documentation related to the planning and scheduling of the Work as described in these Terms and Conditions.

2.2.51. SHOP DRAWINGS (DEFINITION)

Drawings, electronic and hard copy, that detail the fabrication, erection, layout and setting drawings; manufacturer's standard drawings; schedules; descriptive literature, catalogs and brochures; performance and test data; wiring and control diagrams; all other drawings and descriptive data pertaining to materials, equipment, piping, duct and conduit systems, and method of construction as may be required to show the JEA Engineer that the proposed materials, equipment or systems and the position thereof are in compliance with the requirements of the Contract Documents.

2.2.52. SOLICITATION

The documents (which may be electronic) issued by JEA's Procurement Department to solicit Bids from Bidders that includes, but is not limited to, the Bid Documents, Bid Workbook, samples of documents, contractual terms and conditions, the Technical Specifications, and associated Addenda.

2.2.53. SUBCONTRACTOR

The legal person, firm, corporation or any other entity or business relationship that provides a portion of the work, or provides supplies and materials, to the Company which has an executed Contract with JEA. JEA is not in privity of contract with the Subcontractor.

2.2.54. SUBSTANTIAL COMPLETION (DEFINITION)

The time when JEA determines that the Work (or a specified part thereof) is substantially complete, in accordance with the Contract Documents. Additionally, all work other than incidental corrective and incidental punch list work items shall be completed. Substantial Completion shall not have been achieved if all systems and parts are not functional, if utilities are not connected and operating normally, if all required regulatory permits and approvals have not been issued, or if all vehicular and pedestrian traffic routes affected by the Work have not been restored. The date of Substantial Completion shall be established in writing by JEA. Recognition of the Work as Substantially Complete, as evidenced by issuance of a Certificate of Substantial Completion, does not represent JEA's Acceptance of the Work.

2.2.55. SUMMARY SCHEDULE

A diagram displaying the Milestones for the Work graphically positioned on a timeline, showing at a minimum the calendar dates on which each Milestone is scheduled to be completed for Acceptance.

2.2.56. SUPPLEMENTAL WORK AUTHORIZATION (SWA)

A written order, issued at the sole discretion of the JEA representative, which incorporates cost or schedule changes into the Contract. The SWA shall be used for increases or decreases in the Contract Price within the SWA amount set forth on the Bid Form, or to make changes in the schedule for performance of the Work, or to authorize the Company to perform changes in the Work.

2.2.57. TASK ORDER

A document that describes the Work or describes a series of tasks that the Company will perform in accordance with the Contract Documents. A Task Order may be issued as an attachment to a Purchase Order, but the Task Order is neither a Purchase Order, nor a Notice to Proceed.

2.2.58. TERM

The period of time during which the Contract is in force or until the Contract's Maximum Indebtedness is reached, whichever occurs first.

2.2.59. UNIT PRICES

The charges to JEA for the performance of each respective unit of Work as stated in the Response Workbook, Bid Form, or Proposal Form, and incorporated into the Contract Documents.

2.2.60. WORK LOCATION (DEFINITION)

The place or places where the Work is performed, excluding the properties of the Company and/or the Subcontractor(s).

2.2.61. WORK OR SCOPE OF SERVICES

Work includes as defined in the Contract Documents all actions, products, documentation, electronic programs, reports, testing, transport, administration, management, services, materials, tools, equipment, and responsibilities to be furnished or performed by the Company under the Contract, together with all other additional necessities that are

not specifically recited in the Contract, but can be reasonably inferred as necessary to complete all obligations and fully satisfy the intent of the Contract.

2.3. CONTRACT DOCUMENTS

2.3.1. ORDER OF PRECEDENCE

The Contract shall consist of JEA's Contract and/or Purchase Order together with the Solicitation including, but not limited to, the executed Bid Documents, which shall be collectively referred to as the Contract Documents. This Contract is the complete agreement between the parties. Parol or extrinsic evidence will not be used to vary or contradict the express terms of this Contract. The Contract Documents are complementary; what is called for by one is binding as if called for by all. The Company shall inform JEA in writing of any conflict, error or discrepancy in the Contract Documents upon discovery. Should the Company proceed with the Work prior to written resolution of the error or conflict by JEA, all Work performed is at the sole risk of the Company. JEA will generally consider this precedence of the Contract Documents in resolving any conflict, error, or discrepancy:

- o Executed Contract Amendments
- o Exhibits to Contract Documents
- o Executed Contract Documents
- o Purchase Order(s)
- o Addenda to JEA Solicitation
- o Drawings associated with this Solicitation
- o Exhibits and Attachments to this Solicitation
- o Technical Specifications associated with this Solicitation
- o This Solicitation
- o Bid Documents
- o References

The figure dimensions on drawings shall govern over scale dimensions. Contract and detailed drawings shall govern over general drawings. The Company shall perform any Work that may reasonably be inferred from the Contract as being required whether or not it is specifically called for. Work, materials or equipment described in words that, so applied, have a well-known technical or trade meaning shall be taken as referring to such recognized standards.

2.4. PRICE AND PAYMENTS

2.4.1. PAYMENTS

2.4.1.1. PAYMENT METHOD - SCHEDULE OF VALUES

The Company shall submit to JEA a monthly Application for Payment that details the Work completed during that month. The Company shall request payment in accordance with the amounts/percentages set forth on the Schedule of Values that the Company submitted prior to the start of the Work. The Schedule of Values is defined as an itemized list that establishes the value of each part of the Work for a stipulated price and for major lump sum items in a unit price contract. JEA will determine, either by measurement or approximation, the final quantities incorporated into the Work under items for which Unit Prices are established in the Contract Documents. JEA's determination as to the quantity of the Work successfully completed shall be final.

2.4.2. OFFSETS

In case the Company is in violation of any requirement of the Contract, JEA may withhold payments that may be due the Company, and may offset existing balances with any JEA incurred costs against funds due the Company

under this and any other Company Contract with JEA, as a result of the violation, or other damages as allowed by the Contract Documents and applicable law.

2.4.3. DISCOUNT PRICING

JEA offers any or all of the following option payment terms, one of which may be executed at the request of the Company by sending an email to the JEA Buyer listed in this Solicitation:

- o 1% 20, net 30
- o 2% 10, net 30

Company may request alternate payment terms for JEA's consideration, however, alternate payment terms are not effective until acceptance by JEA in writing. Please note, all payment dates are calculated from the date of the Invoice receipt by JEA's Accounts Payable.

2.4.4. COST SAVINGS PLAN

During the Term of this Contract, JEA and Company are encouraged to identify ways to reduce the total cost to JEA related to the Work provided by the Company ("Cost Savings Plan"). JEA and Company may negotiate Amendments to this Contract that support and allow such reductions in total costs including, but not limited to, the sharing of savings resulting from implementation of cost-reducing initiatives between JEA and Company. The decision to accept any cost savings plan shall be in the sole discretion of JEA, and JEA shall not be liable to Company for any cost that may be alleged to be related to a refusal to accept a Cost Savings Plan proposed by Company.

2.4.5. TAXES

JEA is authorized to self-accrue the Florida Sales and Use Tax and is exempt from Manufacturer's Federal Excise Tax when purchasing tangible personal property for its direct consumption.

2.4.6. GENERAL CONDITIONS/SPECIAL CONDITIONS

The line item shown on the Bid Form titled "General/Special Conditions Lump Sum Price" shall be used for general and special expenses which do not appear as separate line items on the Bid Form, including, but not limited to, costs and expenses related to the following:

- o The execution and recording of the Payment and Performance Bonds
- o Safety requirements
- o Quality Control
- o Preparation of daily reports
- o Maintenance of traffic
- o Attendance of meetings, project scheduling
- o Testing (if not included elsewhere)

Except as provided below for expenses related to Bonds and Surveying, JEA's payment for the General/Special Conditions line item shall be based upon the percentage of Work completed.

Bonds - Company will be permitted to invoice JEA, in its first payment application, for the costs associated with the execution and recording of the Payment and Performance Bonds. The amount paid by JEA for the Payment and Performance Bonds will be deducted from the General/Special Conditions line item total.

Surveying - Prior to construction, the Company will be permitted to invoice JEA for the costs associated with the survey of the existing roadway horizontal alignment. The amount paid by JEA for these costs will be deducted from the General/Special Conditions line item total.

SWA - In the event that JEA authorizes changes to the Work under a Supplemental Work Authorization (SWA), the amount of the Bid Form line item for SWA Allowance will not be increased unless the total value of all SWA Work exceeds the Original SWA Allowance provided on the Bid Form.

2.4.7. JSEB COMPLIANCE

2.4.7.1. COMPLIANCE WITH JSEB REQUIREMENTS

The Company shall achieve the JSEB participation requirements as set forth in the Solicitation, except as allowed under the good faith efforts exception as defined in the City of Jacksonville Ordinance. In no case shall the Company make changes to the JSEB firms listed in its Bid, revise the JSEB scope of Work or amount of Work as stated in its Bid without prior written notice to the Contract Administrator, and without subsequent receipt of written approval from the Contract Administrator.

The City of Jacksonville requirements as outlined in the City of Jacksonville Ordinance relating to JSEBs shall apply in their entirety to this Contract. Where the City of Jacksonville ordinance refers to "Chief", it shall be construed to mean, for purposes of this Contract, JEA's Chief Purchasing Officer. In a like manner, where it refers to "City", or "City of Jacksonville", it shall be construed to mean JEA.

Use of brokering, as defined in the City of Jacksonville Ordinance, or other techniques that do not provide a commercially useful function are strictly prohibited as means of achieving the JSEB requirements of the Contract. Only the amount of fees or commissions charged by a JSEB for providing a bona fide service such as professional, technical, consultant, or managerial services, or for providing bonds or insurance specifically required for the performance of a contract shall be counted towards a JSEB participation requirement, provided the fee is reasonable and not excessive as compared with fees customarily charged for similar services.

Payment terms for participating JSEB firms shall be the same or better than the payment terms the Company receives from JEA, except that in all cases JSEB firms shall be allowed to submit invoices to the Company at least bimonthly, and the Company shall pay proper invoices no later than three (3) days after its receipt of JEA payment. The Company shall obtain written approval from the Contract Administrator prior to withholding any payment from JSEB firm.

If the Company uses a JSEB qualified firm for the performance of any part of this Work, the Company shall submit to JEA, with its Invoice, a listing of JSEB qualified firms that have participated in the Work. Such listing shall be made using the form "Monthly Report for COJ/JEA JSEB Participation" available at www.jea.com

The Company agrees to let JEA audit its financial and operating records with one (1) day of notice, and during normal business hours, at its corporate offices for the purpose of determining compliance with all JSEB requirements of the Contract Documents.

If the Company violates any provision regarding JSEB, including, but not limited to, program intent, the Company shall be subject to any or all of the following, plus any other remedies available to JEA under law:

- o Terminate the Contract for breach
- o Suspend the Company from bidding any JEA projects as follows:
- o First offense: Six (6) months

- o Second offense: One (1) year
- o Third offense: Three (3) years
- o Revoke Company's JSEB certification if the Company itself is certified as a JSEB.

2.4.8. JSEB - INVOICING AND PAYMENT

If the Company utilizes JSEB certified firms, regardless of whether these Contract Documents require or encourage the use of such firms, the Company shall Invoice for and report the use of JSEB certified firms according to the format and guidelines established by the City of Jacksonville.

2.4.9. INVOICING AND PAYMENT TERMS AND RETAINAGE

Within sixty (60) days of completion of the Work, the Company shall submit all Invoices or Applications for Payment in accordance with the payment method agreed upon in these Contract Documents. All Invoices shall be submitted to the following address:

JEA Accounts Payable
P.O. Box 4910
Jacksonville, FL 32201-4910

JEA will pay the Company the amount requested less any holdbacks or retainage set forth in herein within thirty (30) calendar days after receipt of an Invoice from the Company subject to the provisions stated below.

JEA may reject any Invoice or Application for Payment within twenty (20) calendar days after receipt. JEA will return the Invoice or Application for Payment to the Company stating the reasons for rejection. Upon receipt of an acceptable revised Invoice or Application for Payment, JEA will pay the Company the revised amount within ten (10) days.

JEA may withhold payment if the Company is in violation of any conditions or terms of the Contract Documents.

As security for the proper performance of the Work, JEA may deduct ten percent (10%) retainage, or such other amount allowable pursuant to Florida law, from the amount stipulated in the Invoice or Application for Payment. In accordance with Florida Statutes, after completion of fifty percent (50%) of the Work, a maximum retainage of five percent (5%) may be deducted. For the purposes of this section, "completion of fifty percent of the Work" shall be defined as the point at which fifty percent of the total cost of the Work, as defined, and inclusive of authorized change orders, has been expended by JEA.

In the case of early termination of the Contract, all payments made by JEA against the Contract Price prior to notice of termination shall be credited to the amount, if any, due the Company. If the parties determine that the sum of all previous payments and credits exceeds the sum due the Company, the Company shall refund the excess amount to JEA within ten (10) days of determination or written notice.

2.4.10. PROMPT PAYMENT TO SUBCONTRACTORS, SUB-SUBCONTRACTORS AND SUPPLIERS

When the Company receives payment from JEA for labor, services or materials furnished by Subcontractors and suppliers that are hired by the Company, the Company shall remit payment due (less proper retainage) to those Subcontractors and suppliers within ten (10) days after the Company's receipt of payment from JEA. Nothing herein shall prohibit the Company from disputing, pursuant to the terms hereof, all or any portion of a payment alleged to be due to its Subcontractors and suppliers. In the event of such dispute, the Company may withhold the disputed portion of any such payment only after the Company has provided written notice to JEA and to the Subcontractor and supplier whose payment is in dispute, stating the amount in dispute and specifically describing the actions required to cure the dispute. The Company shall deliver such notice to JEA and to the said Subcontractor or supplier

within ten (10) days following the Company's receipt of payment from JEA. The Company shall pay all undisputed amounts due within the time frames specified herein.

The prompt payment requirements herein shall, in no way, create any contractual relationship or obligation between JEA and any Subcontractor, supplier, JSEB, or any third-party, nor create any JEA liability for the Company's failure to make timely payments as required. The Company's failure to comply with the prompt payment requirements, however, shall constitute a material breach of its contractual obligations to JEA. As a result of such breach, JEA, without waiving any other available remedy it may have against the Company, may issue joint checks and charge the Company a 0.2% daily late payment interest charge or charges as specified within the Florida Statutes, whichever is greater.

2.4.11. PUNCH LIST: SECTION 218.735, FLORIDA STATUTES

Within thirty (30) calendar days after reaching Substantial Completion, as defined herein, the parties shall jointly develop a final list of items required to render the Work complete, satisfactory, and acceptable (the "Punchlist"). If the parties cannot agree on the Punchlist, JEA will develop a Punchlist and deliver it to Company within thirty-five (35) days after Substantial Completion. If the Work involves more than one (1) building or structure or involves a multi-phased project, one (1) Punchlist should be developed for each building, structure, or phase. Failure to include corrective work on the Punchlist does not relieve the Company from its responsibility to complete the Work required by the Contract.

Final Completion must be achieved within thirty (30) days after delivery of the Punchlist to Company. Notwithstanding anything in the Contract Documents to the contrary, damages may not be assessed against Company for failing to complete the Work unless Company fails to complete the Work within such thirty (30) day period.

2.4.12. SUBSTANTIAL COMPLETION

The Company shall notify JEA in writing when a portion of the Work is Substantially Complete. The Company shall identify any deficiencies in the Work. JEA will inspect the Work and will give the Company written notice of either acceptance or rejection of the Work as Substantially Complete and provide a list of additional deficiencies. The Company shall correct all deficiencies prior to Final Completion of the Work by JEA.

Whenever any portion of the Work is Substantially Complete, JEA may use it. Such use shall not be held in any way as an Acceptance of the Work or as a waiver of any provisions of the Contract.

2.4.13. CERTIFICATE OF CONTRACT COMPLETION AND FINAL PAYMENT

Company shall complete and submit to JEA the Certificate of Contract Completion, which can be found on jea.com, as notice that the Work, including the correction of all deficiencies outlined in the Punchlist, is complete.

By submitting the certificate, the Company certifies the following:

- o The Work, including all Punchlist items, has been satisfactorily completed; and
- o No liens have attached against the property and improvements of JEA; and
- o No notice of intention to claim liens are outstanding; and
- o No suits are pending by reason of the Work; and
- o All workers' compensation claims known to the Company have been reported to JEA; and
- o The surety provides a release; and
- o All warranties, equipment manuals and other documentation have been provided; and
- o No public liability claims are pending.

The Company shall submit its final Invoice with the completed Certificate of Contract Completion. JEA shall make Final Payment in accordance with the provisions contained herein. Final Payment includes payment of any retainage held.

2.5. SCHEDULES, REPORTING REQUIREMENTS AND LIQUIDATED DAMAGES

2.5.1. CRITICAL PATH METHOD (CPM) SCHEDULING (UNDER \$5 MILLION)

The Contractor shall use the Critical Path Method (CPM) to schedule and manage the Work. A qualified member of the Contractor's personnel shall do scheduling using CPM. If the Contractor does not have staff capable of preparing and managing CPM schedules, the Contractor shall obtain such qualified personnel on a subcontract basis for the purpose of supporting this Contract.

All CPM scheduling will be performed using CPM precedence diagramming method (PDM) scheduling software such as, Primavera P3, Primavera SureTrak (a low-cost CPM software for small businesses), Primavera P3e/c for construction, Primavera Contractor, Artemis Artviews, or a CPM scheduling software compatible with Primavera P3e import capabilities, integrated as part of a Contractor-wide ERP. The Contractor shall submit all schedules and associated reports to the Contract Administrator in paper and/or electronic formats as described below in order to allow both complete analysis of the schedules and accurate record keeping.

CPM Schedule Terminology:

"Activity" means any single, continuous, identifiable task in the total Work. The project work scope is sub-divided into work tasks that are represented in the schedule software as activities. How finely the project scope is subdivided into tasks determines the "level of detail" within the schedule. JEA retains the right to reject a schedule for insufficient levels of activity detail.

"Milestone" or "Event" means the instant of time at which a significant task within the project is commencing or completing. A milestone or event is an activity in the scheduling software with an estimated duration of zero.

"Precedence relationships" means the logical relationships created in the scheduling software to sequence the performance of the work tasks identified by activities or milestones. Precedence relationships can be categorized in 4 groups - Finish-to-start, Start-to-Start, Finish-to-Finish, and Start-to-Finish. The interface between activities created by precedence relationships creates a PDM network logic. A PDM logic where estimated durations have not been assigned to the activities constitutes a network "Plan". Once activities are assigned estimated durations, the software interfaces durations and the network logic to calculate a "Schedule" based on the Plan.

"Initial Schedule" means the schedule that is proposed before any work has commenced against the project. The initial schedule differs from a current schedule only such that no activities have begun. Initial Schedules are usually the first schedules submitted for approval to the JEA representative. An Initial Schedule has no standing and is considered a working document or proposal.

"Current Schedule" means the schedule that has progress information (updates) reported against in-progress and completed activities. Update information is used to re-calculate / reforecast the most likely "early start" dates of the remaining incomplete activities as sequenced by the Plan. This calculation establishes to the earliest forecasted completion date of the project which allows project managers to determine if they are ahead, on, or behind schedule to meet the contractual completion date. A current schedule has no standing and is considered a working document to evaluate progress against an Approved Schedule.

"Original Schedule" is the first schedule that is approved by the JEA representative. In some extraordinary cases a Current Schedule may be accepted as the Original Schedule if no Initial Schedule is approved before work commences. The Original Schedule is the first schedule that is "targeted" as an Approved Schedule.

"Target Schedule" means a copy of the schedule where dates are frozen and those dates are not allowed to be modified by progress reporting, schedule changes, or further recalculations. Target Schedules take current schedule information which is dynamic and establishes static schedule data for comparison purposes. A project can have multiple Target Schedules (i.e. - copies of the schedule made at different times during project execution). The Original Schedule is usually the first Target Schedule to be generated within a project.

"Approved Schedule" is the Target Schedule that is approved by the JEA Representative. An Approved Schedule is the official schedule used to measure schedule performance against the Current Schedule. The first Approved Schedule is the Original Schedule and subsequent Approved Schedules are generated when the JEA representative agrees to revision(s) of the Approved Schedule. The Approved Schedule may be referred to as the Baseline Schedule or current Baseline Schedule.

"CPM Network" means a transferable electronic copy of project software data and files and includes, but is not limited to, activities, milestones, calendar definitions, precedence relationships including any relationship lag periods, date constraints (e.g. start on or before, start on or after, finish on, finish on or before, finish on or after, as late as possible, zero free float, zero total float, etc.), target schedules, project and activity code definitions, resource definitions, resource assignments, project values (e.g. the data date/time now value, settings for project-activity processing options, etc.), and all information that can be generated from such data.

Schedule Requirements

General - The Contractor is advised that its schedule and reports as specified herein will be an integral part of JEA's management program. The Contractor's schedules will be used by JEA to monitor project progress, plan the level of effort by its own forces and consultants, and as a critical decision making tool. Accordingly, the Contractor shall ensure that it complies fully with the requirements specified herein and that its schedules are both timely and accurate throughout the duration of the project.

Duration Estimates - The basic time unit for the duration estimate shall be in calendar days, except for plant outage work, which if requested by JEA, shall be measured at JEA's determination by work shifts or clock hours. For the purpose of scheduling, no schedule activity, outside of a plant outage, shall be estimated in duration units other than whole calendar days. The Contractor shall show each estimated duration on each Schedule (Initial or Current), indicating the best estimate of the activity's duration considering the scope of the Work and resources planned for the activity.

Calendars - The Contractor will specify the work pattern (calendar) to be used on the job (default) and the work pattern assigned to each activity - whether it is a four (4) day – ten (10) hour/day week, five (5) day – eight (8) hour/day week, etc.

Holidays - Holidays are to be observed and shall be identified as non-work days occurring during a regular work week pattern.

Level of Schedule Detail - JEA retains the right to reject an Initial or Current Schedule if insufficient level of detail in the schedule would inhibit meaningful schedule analysis or progress reporting used to evaluate progress of the project. Except for certain non-labor activities such as procurement or delivering of materials, activity durations "should" not exceed fourteen (14) days, nor be shown as less than one (1) working day unless otherwise accepted by JEA. The "guideline" for activity durations not in excess of fourteen (14) days shall apply to all schedule

submittals. JEA shall be the final authority regarding the appropriate level of schedule detail for all schedules submitted for approval.

Activity and Project Codes - The Contractor may use activity and project codes to support organization and displays of the schedule information if such information is transmitted to JEA with the Initial schedules. JEA shall be notified if additional codes are defined and utilized over the course of the project. At times, JEA may request that certain codes are applied to activities to facilitate the interface between the Contractor's schedule software and JEA's schedule software.

PDM Network Quality - Each project shall establish a "Start of Project" and "Project Completion/End of Project" milestone. All other activities within the schedule shall have precedence relationships that logically sequence both the start (predecessor) and finish (successor) of each activity. JEA will review the CPM Plan for excessive front loaded and back loaded work activity periods. Heavy front or back loaded schedules may indicate the lack of a well-designed Plan, poor network logic or poor utilization of available resources.

Submittal Process for Establishing an Approved Schedule:

Planning Session - Within three (3) days of Purchase Order issuance, and prior to submission of the Initial Schedule, the Contractor shall schedule and conduct a schedule planning session. During this session, the Contractor shall present its planned approach to the project including but not limited to: the planned construction sequence and phasing, planned crew sizes, summary of equipment types/sizes/numbers to be used, estimated durations of major work activities, the anticipated critical path of the project and a summary of the activities on the critical path, and a summary of the most difficult schedule challenges the Contractor is anticipating and how it plans to manage/control these challenges. This will be an interactive session with JEA. The Contractor's Initial Schedule shall incorporate the information discussed at this schedule planning session.

Initial Schedule - Within fourteen (14) days of the Planning Session, the Contractor shall submit a proposed CPM schedule consisting of Schedule deliverables as described herein. This schedule shall indicate project completion within the Contract Time. JEA shall contact a representative of the Contractor to review any discrepancies or items requiring clarification of the proposed Work schedule.

The Initial Schedule shall be reviewed and approved, or rejected by JEA within ten (10) days of submission. Failure to gain approval of the Initial Schedule within twenty-one (21) calendar days of submittal can result in Contract cancellation. The submitted CPM Network and schedule reports, when approved by JEA, shall constitute the Approved Schedule, until circumstances change and shall warrant the Contractor to request, and JEA to approve, a revised Approved Schedule.

Schedule Deliverables:

The Contractor shall submit the following for the Initial Schedule and for each version of their Current schedule where they seek a revision to the Approved Schedule.

1. A tabular schedule report which includes:

Activity ID, activity description/name, activity calendar, original duration in calendar days, early start date, early finish date, total float, imposed date type, and imposed date (also known as "constrained date"), Approved Schedule Target Start Date, and Approved Schedule Target Finish Date

Sort criteria used on the report

Description of Grouping or sectioning criteria if used

No activities will be filtered, hidden, or removed from these reports.

If any of the above fields are too wide for a single tabular report, then the Contractor shall split some of the fields into a second report that also repeats activity ID and activity name, with the same sectioning, sorting and selection.

2. A second report (a Gantt chart) that includes the following:

Tabular fields: activity ID, activity name, remaining duration, early start date, early finish date, total float.

Graphic bars showing:

- i. Early date set: early start to early finish (including actual start to actual finish if the activity is completed). This bar must highlight activities, preferably in red, with total float values equal to 0 or less.
- ii. Late date set: late start to late finish (a separate, less prominent bar beneath early date set).
- iii. Approved (Target) Schedule date set: a separate, less prominent bar beneath the late date set bar that highlights the original target dates. This bar is static, while the schedule bars for early and late dates will become dynamic during schedule execution.
- iv. Milestone flags and constrained date flags: these are icons that show up as points in time (events). (Normally, they can share the same bar row as early date set).

Sort criteria

- i. Grouping: sectioning appropriate to the scope of the project
- ii. Sorting: sub grouping under each section by early start date (primary sort), by early finish date (secondary sort), total float (third-level sort), and by activity ID (final sort).

Selection: all activities

3. A document explaining the basis and purpose of any relationship lag values between activities in the CPM network.
4. An electronic copy of the Schedule data files from one (1) of the Primavera schedule software systems which will allow JEA to generate the products identified above based on the vendors schedule information/ raw data.
5. The Contractor shall also submit a list of project definitions including: calendar definitions indicating holidays, other non-work periods, normal planned work pattern (e.g. Eight (8) hours per day, Five (5) days per week; Ten (10) hours per day, Four (4) days per week), any activity code definitions if any of the items have been altered since the previous submission.

Schedule Acceptance:

The JEA representative shall inform the Contractor when the Initial Schedule or a Current Schedule has been accepted as the Accepted Schedule. No changes reflected in an Approved Schedule will be construed as authorization to

override the contractual completion date agreement. Changes to the contractual completion date must be amended outside the schedule review process.

Schedule Revisions:

The Contractor shall modify any portions of the Current Schedule that become infeasible because of "activities or procurement behind schedule" or for any other valid reason. An activity that cannot be completed by its late finish date shall be deemed to be behind schedule. If the Contractor makes logic changes to the CPM network, adds, deletes, or modifies activities and wishes to establish a new Approved Schedule, it will be required to resubmit the same information that was originally submitted for the Approved Schedule. The submittal may be included as part of the update process with the Current Schedule, however none of the additions, deletions, or modifications to the schedule are approved until the JEA Contract Manager formally approves the changes as a revised Approved Schedule. JEA shall approve or reject an Initial or Current schedule submitted for the purpose of establishing an Approved Schedule within ten (10) calendar days of submittal and in any situation before the next periodic update is due. Schedule revisions shall be designed to document how the Contractor intends to accomplish the Work by the date stated for Final Completion.

Change Orders:

Upon issuance of a Change Order, the Contractor shall indicate the approved change in the next submittal of the Current schedule by coding criteria and within the activity description so the JEA Representative may easily identify Change Order activities wherever they appear in the schedule.

Schedule Updates:

The Contractor shall update the Current Schedule monthly or periodically as indicated in the Contract Documents, in order to show Work that is ahead of or behind the Approved Schedule. The Current schedule may indicate that an activity is ahead of or behind the targeted schedule and may show the Contractor's revised plan to meet the original dates by working overtime, weekends, or in drastic cases, revising the Work sequence/logic to recover time. Such reporting does not infer that changes to the schedule are authorized or agreed to by JEA.

The Contractor shall provide monthly schedule updates using a process which includes:

1. Determining a new data date (time now) value, against which the progress of all activities in the CPM network will be reported. Many activities may not be affected by the update because they remain planned, or were completed during a previous update cycle.
2. Based on the selected data date, review each activity for the following criteria:
 - If an activity has started and the actual start date has not been previously reported, record an actual start date.
 - If an activity has finished and the actual finish date has not been previously reported, record an actual finish date.
 - If the activity has started, but not finished, also report an expected finish date or report a remaining duration in days based on the activity work pattern (calendar).
3. When this data has been recorded analyze the PDM network to recalculate/ reforecast the Current Schedule dates based on progress reporting, remaining durations, relationships, and date constraints.

4. The Contractor shall review the schedule analysis results and determine if they are acceptable. If the results are not acceptable, the Contractor shall notify the JEA Representative such that the Contract Administrator may be aware that corrective action is needed by the Contractor to meet the schedule.
5. The Contractor shall publish and distribute the Current Schedule to show the impact of the progress reporting against the Approved Schedule.

The Contractor, after updating and issuing the Current Schedule, may choose to attempt to recover lost time through improved productivity, additional work hours or logic changes. They may submit their schedule changes to the JEA Contract Manager as a request for a revised Approved Schedule as described in the Schedule Revisions section.

The revised Approved Schedule grants permission to change the Target Schedule as the basis for measuring whether Work is ahead of schedule, on schedule or behind schedule. The documentation required for approval of a revised Approved Schedule will be the same as the documentation required for the initial Approved Schedule.

The current Progress Schedule Submittal should incorporate all proposed Activity, logic and restraint date revisions required to (a) implement changes in the Work, (b) detail all impacts on pre-existing Activities, sequences and restraint dates, (c) recover schedule, (d) reflect the Contractor's current approach for Work remaining, (e) incorporate any Delays that are being negotiated between the JEA and Contractor, and (f) reflect "or equal" or substitution proposals.

Schedule Monitoring:

The JEA representative has the right to withhold or delay approval of an Application for Payment based on failure to provide schedule updates or to exhibit project progress as shown on the Current Schedule when compared to the Approved Schedule. This section in no way limits or restricts Application for Payment standards set elsewhere in the contract. The Contractor agrees to and guarantees that they will not: misrepresent its scheduling or execution of the work; utilize schedules substantially different from those submitted to JEA for performance or coordination of the work; or submit schedules that do not accurately reflect the intent or reasonable expectations of the Contractor or its subcontractors.

Use of Float:

Contract Float is not for the exclusive use or benefit of either JEA or the Contractor, but must be used in the best interest of completing the project within the Contract Time. If the Early Dates in any Progress Schedule Submittal forecast any slippage or overrun of the Contract Times, the Contractor shall indicate such slippage or overrun by reporting negative Contract Float.

The Contractor shall explain the rationale for use of any: (1) float suppression techniques in the Construction Schedule including but not limited to interim dates imposed by the Contractor other than Contract Time(s) and Contract Milestone(s), or (2) the inclusion of activities or constraints in a path or chain leading to a Contract Milestone which are unrelated to the Work as stated and specified in the Contract Documents, or (3) activity durations or sequences deemed by JEA to be unreasonable in whole or in part.

All Contract Time(s) and Milestones shall be imposed, coded and separately identified in all Progress Schedule Submittals in conformance with the Milestone(s) and Contract Times(s) set forth in the Contract Documents. The Contractor shall impose no other date restraints in the Construction Schedule, unless an explanation of their bases is provided and is acceptable to JEA. Contract Completion and Milestones incorporated in the Contractor's Construction Schedule shall be assigned duration of zero (0) days.

Extensions of time for performance of the Work required under the General Conditions pertaining to equitable time adjustment will be granted only to the extent that the equitable time adjustment for activities affected by any condition or event which entitles the Contractor to a time extension exceed the Contract Float along the path of the activities

affected at the time of Notice to Proceed of a Contract Modification or commencement of any delay or condition for which an adjustment is warranted under the Contract Documents.

If the Contractor is delayed in performing the Work, the Contractor shall absorb any related delay, disruption, interference, hindrance, extension or acceleration costs, however caused until all Contract Float, if any, is consumed and performance or completion of the Work or specified part, necessarily extends beyond the corresponding Contract Times. The Contractor shall work cooperatively with JEA, adjacent Contractors, and third parties, to identify and implement to the maximum extent possible, no-cost measures to recover all schedule delays, regardless of the cause of the delays. One (1) example of such measures is no-cost re-sequencing of Work Activities.

Delay Provisions:

Review with JEA progress of work at the Construction Progress Meetings. Unless otherwise directed in writing by the JEA, whenever this review as determined by JEA indicates a late completion of the work or should activities shown on the Progress Schedule submittal slip by ten (10) or more days beyond any Contract Time or Milestones, a recovery schedule shall be prepared and submitted. The Contractor shall work cooperatively with JEA's adjacent Contractors, and third parties, to identify and implement to the maximum extent possible, no-cost measures to recover all schedule delays, regardless of the cause of the delays. One (1) example of such measures is no-cost re-sequencing of Work activities. The Contractor shall be required to, at no extra cost to JEA, prepare and submit a recovery schedule which displays how the Contractor intends to reschedule those activities, in order to regain compliance with the Contract Time or Milestones. The Contractor will also submit a narrative, which shall describe the cause of schedule slippage and actions taken to recover schedule within the shortest reasonable time (e.g., re-sequencing of Work activities, hiring of additional labor, use of additional construction equipment, expediting of deliveries, etc.).

Schedule recovery will be excused if the Contractor requests and demonstrates entitlement to an extension in Contract Time, in writing, due to delay(s) not within the control of the Contractor, and JEA concurs schedule recovery is not required at that time. Any Contractor request for adjustment in Contract Time and Contract Price will not be evaluated unless (a) the Contractor, using the procedures in this Section and the Contract, shows that conditions justifying adjustments in Contract Time and/or Contract Price have arisen, (b) the Contractor's analysis is verifiable through an independent review by JEA of the electronic disk files for the Progress Schedule Submittal provided by the Contractor, and (c) the Contractor provides adequate documentation (in the form of daily field reports, field records, correspondence, photos, videos, invoices, certified payrolls, narratives, U.S. Weather Bureau reports, etc.) to substantiate its position, to the satisfaction of JEA.

The Contractor shall include in the schedule a subnet demonstrating how the Contractor proposes to incorporate each Change Order into the most recently accepted Schedule. A subnet is defined as a sequence of new or revised activities that are proposed to be added to the Schedule.

The extension of Contract Time shall be considered only if the Contractor demonstrates via the timely submittal of a detailed schedule analysis that they are entitled to the time by using a methodology acceptable to JEA. The analysis shall include: a) a detailed narrative which clearly describes the events causing the delay and the resulting impacts to the critical path of the project schedule, b) documentation substantiating and supporting the delay, c) detailed CPM schedules (both electronic and hard copies) clearly delineating the delay, d) a matrix showing delays caused by JEA, delays caused by the Contractor, delays caused by any third party and any force majeure delays; e) any additional information reasonably requested by JEA, in order to enable JEA to perform a timely and informed analysis of the request for extension of Contract Time.

2.5.2. LIQUIDATED DAMAGES UNTIL ACCEPTANCE

If the Company fails to obtain JEA's Acceptance of the Work on or before 220 days after date of Notice to Proceed, the Company shall pay JEA the sum of \$10,000.00 per day for each and every calendar day, including Sundays and

Holidays, starting on the day the Work was deemed by JEA to be Substantially Complete until the date the Work is Accepted by JEA.

Liquidated Damages are capped at a maximum of ten percent (10%) of the Contract Price.

The Company understands and agrees that said daily sum is to be paid not as a penalty, but as compensation to JEA as a fixed and reasonable liquidated damages for losses that JEA will suffer because of such default, whether through increased administrative and engineering costs, interference with JEA's normal operations, other tangible and intangible costs, or otherwise, which costs will be impossible or impractical to measure or ascertain with any reasonable specificity.

Liquidated damages may, at JEA's sole discretion, be deducted from any monies held by JEA that are otherwise payable to Company.

The Company's responsibility for liquidated damages shall in no way relieve the Company of any other obligations under the Contract.

2.5.3. REPORTING (CONSTRUCTION)

The Company shall provide all reports as defined in the Contract Documents.

Where the reporting frequency is daily, reports shall be submitted by noon of the following workday. Where the reporting frequency is weekly, reports are due by Monday at noon, covering the prior workweek. Where Monday is a Holiday, the reports are due at noon on the next workday. Where reports are due monthly, reports are due by noon on the first business day of each month. Sample forms for reports may be included in the Contract Documents. Where they are included, they are to be used. Where they are not included, the Company shall provide a sample of its proposed report format for each report to the Contract Administrator at least one (1)-week prior to its initial due date. The Contract Administrator will review and either approve or reject use of the report. Where proposed report is rejected, Company shall resubmit revised report formats, until Contract Administrator approves format. Reporting cycle shall begin upon the Purchase Order date, or, if used, the issuance date of the Notice to Proceed.

Where the Contract calls for reports to be submitted by Company, such reports shall be in both paper and electronic format, with the electronic version submitted electronically via email to the Contract Administrator.

2.5.4. WORK SCHEDULES

The Approved Schedule is referenced in the Technical Specifications attached to this Solicitation. If no schedule is provided, then the established schedule is based on working five (5) days per week, single shift, eight (8) hours per day or four (4) days per week, single shift, ten (10) hours per day. JEA may require the Company to base its schedule on an accelerated Work schedule or multiple shifts. The Company shall not schedule work on Holidays without obtaining prior written approval from JEA.

The Company shall, at no additional cost to JEA, increase or supplement its working force and equipment and perform the Work on an overtime or multiple shift basis when directed by JEA and upon notification that the Company is behind schedule. The Company shall submit a revised schedule in writing demonstrating the Company's schedule recovery plans.

The Company understands and agrees that the rate of progress set forth in the Approved Schedule already allows for ordinary delays incident to the Work. No extension of the Contract Term will be made for ordinary delays, inclement weather, or accidents, and the occurrence of such events will not relieve the Company from requirement of meeting the approved schedule.

2.6. WARRANTIES AND REPRESENTATIONS

2.6.1. WARRANTY (CONSTRUCTION)

Unless otherwise stated herein, the Company unconditionally warrants to JEA for a period of not less than **TWO** (2) year(s) from the date of issuance of the Certificate of Substantial Completion, that all Work furnished under the Contract, including but not limited to, materials, equipment, workmanship, and intellectual property, including derivative works will be:

- o Performed in a safe, professional and workman like manner; and
- o Free from Defects in design, material, and workmanship; and
- o Fit for the use and purpose specified or referred to in the Contract; and
- o Suitable for any other use or purpose as represented in writing by the Contractor; and
- o In conformance with the Contract Documents; and
- o Merchantable, new and of first-class quality.

The Company warrants that the Work shall conform to all applicable standards and regulations promulgated by federal, state, local laws and regulations, standards boards, organizations of the Department of State, and adopted industry association standards. If the Work fails to conform to such laws, rules, standards and regulations, JEA may return the Work for correction or replacement at the Company's expense, or return the Work at the Company's expense and terminate the Contract.

If the Company performs services that fail to conform to such standards and regulations or to the warranties set forth in the first paragraph of this Section, the Company shall make the necessary corrections at Company's expense. JEA may correct any services to comply with standards and regulations at the Company's expense if the Company fails to make the appropriate corrections within a reasonable time after notice of the Defect from JEA.

If Work includes items covered under a manufacturer's or Subcontractor's warranty that exceeds the requirements stated herein, Company shall transfer such warranty to JEA. Such warranties, do not in any way limit the warranty provided by the Company to JEA.

If, within the warranty period, JEA determines that any of the Work is defective or exhibit signs of excessive deterioration, the Company at its own expense, shall repair, adjust, or replace the defective Work to the complete satisfaction of JEA. The Company shall pay all costs of removal, transportation, reinstallation, repair, and all other associated costs incurred in connection with correcting such Defects in the Work. The Company shall correct any Defects only at times designated by JEA. The Company shall extend the warranty period an additional 12 months for any portion of the Work that has undergone warranty repair or replacement, but in no case shall the maximum warranty period be extended beyond thirty-six (36) months.

JEA may repair or replace any defective Work at the Company's expense when the Company fails to correct the Defect within a reasonable time of receiving written notification of the Defect by JEA, when the Company is unable to respond in an emergency situation or when necessary to prevent JEA from substantial financial loss. Where JEA makes repairs or replaces defective Work, JEA will issue the Company a written accounting and invoice of all repair work required to correct the Defects.

Where spare parts may be needed, Company warrants that spare parts will be available to JEA for purchase for at least seventy-five percent (75%) of the stated useful life of the product.

The Company's warranty excludes any remedy for damage or Defect caused by abuse, improper or insufficient maintenance, improper operation, or wear and tear under normal usage.

Note that JEA intends to perform a warranty inspection prior to the expiration of the warranty period. JEA will notify the Company and the Company Representative shall attend the inspection. All discrepancies identified at said inspection shall be corrected by the Company within a reasonable timeframe.

2.7. INSURANCE, INDEMNITY AND RISK OF LOSS

2.7.1. INSURANCE

INSURANCE REQUIREMENTS

Before starting and until acceptance of the Work by JEA, and without further limiting its liability under the Contract, Company shall procure and maintain at its sole expense, insurance of the types and in the minimum amounts stated below:

Workers' Compensation

Florida Statutory coverage and Employer's Liability (including appropriate Federal Acts); Insurance Limits: Statutory Limits (Workers' Compensation) \$500,000 each accident (Employer's Liability).

Commercial General Liability

Premises-Operations, Products-Completed Operations, Contractual Liability, Independent Contractors, Broad Form Property Damage, Explosion, Collapse and Underground, Hazards (XCU Coverage) as appropriate; Insurance Limits: \$1,000,000 each occurrence, \$2,000,000 annual aggregate for bodily injury and property damage, combined single limit.

Automobile Liability

All autos-owned, hired, or non-owned; Insurance Limits: \$1,000,000 each occurrence, combined single limit.

Excess or Umbrella Liability

(This is additional coverage and limits above the following primary insurance: Employer's Liability, Commercial General Liability, and Automobile Liability); Insurance Limits: \$4,000,000 each occurrence and annual aggregate.

Company's Commercial General Liability and Excess or Umbrella Liability policies shall be effective for two (2) years after Work is complete. The Indemnification provision provided herein is separate and is not limited by the type of insurance or insurance amounts stated above.

Company shall specify JEA as an additional insured for all coverage except Workers' Compensation and Employer's Liability. Such insurance shall be primary to any and all other insurance or self-insurance maintained by JEA. Company shall include a Waiver of Subrogation on all required insurance in favor of JEA, its board members, officers, employees, agents, successors and assigns.

Such insurance shall be written by a company or companies licensed to do business in the State of Florida and satisfactory to JEA. Prior to commencing any Work under this Contract, certificates evidencing the maintenance of the insurance shall be furnished to JEA for approval. Company's and its subcontractors' Certificates of Insurance shall be mailed to JEA (Attn. Procurement Services), Customer Care Center, 6th Floor, 21 West Church Street, Jacksonville, FL 32202-3139.

The insurance certificates shall provide that no material alteration or cancellation, including expiration and non-renewal, shall be effective until thirty (30) days after receipt of written notice by JEA.

Any subcontractors of Company shall procure and maintain the insurance required of Company hereunder during the life of the subcontracts. Subcontractors' insurance may be either by separate coverage or by endorsement under insurance provided by Company. Note: Any JSEB firms identified by Bidders for this Solicitation are considered "Subcontractors" under the direct supervision of the Prime or General Contractor (herein referred to as "Company"). Companies should show good faith efforts in providing assistance to JSEB firms in the securing of the Subcontractors' insurance requirements stated herein. Company shall submit subcontractors' certificates of insurance to JEA prior to allowing Subcontractors to perform Work on JEA's job sites.

2.7.2. INDEMNIFICATION (JEA STANDARD)

For ten dollars (\$10.00) acknowledged to be included and paid for in the contract price and other good and valuable considerations, the Company shall hold harmless and indemnify JEA against any claim, action, loss, damage, injury, liability, cost and expense of whatsoever kind or nature (including, but not by way of limitation, reasonable attorney's fees and court costs) arising out of injury (whether mental or corporeal) to persons, including death, or damage to property, arising out of or incidental to the negligence, recklessness or intentional wrongful misconduct of the Company and any person or entity used by Company in the performance of this Contract or Work performed thereunder. For purposes of this Indemnification, the term "JEA" shall mean JEA as a body politic and corporate and shall include its governing board, officers, employees, agents, successors and assigns. This indemnification shall survive the term of a Contract entered into pursuant to this solicitation, for events that occurred during the Contract term. This indemnification shall be separate and apart from, and in addition to, any other indemnification provisions set forth elsewhere in this Contract.

2.7.3. ENVIRONMENTAL INDEMNIFICATION

The Company shall hold harmless and indemnify JEA including without limitation, its officers, directors, members, representatives, affiliates, agents and employees, successors and assigns (the "Indemnified Parties") and will reimburse the Indemnified Parties from and against any and all claims, suits, demands, judgments, losses, costs, fines, penalties, damages, liabilities and expenses (including all costs of cleanup, containment or other remediation, and all costs for investigation and defense thereof including, but not limited to, court costs, reasonable expert witness fees and attorney fees) arising from or in connection with (a) the Company's, including, but not limited to, its agents, affiliates or assigns ("Parties"), actions or activities that result in a violation of any environmental law, ordinance, rule, or regulation or that leads to an environmental claim or citation or to damages due to the Company's or other Parties' activities, (b) any environmental, health and safety liabilities arising out of or relating to the operation or other activities performed in connection with this Contract by the Company or any Party at any time on or after the effective date of the Contract, or (c) any bodily injury (including illness, disability and death, regardless of when any such bodily injury occurred, was incurred or manifested itself), personal injury, property damage (including trespass, nuisance, wrongful eviction and deprivation of the use of real property) or other damage of or to any person in any way arising from or allegedly arising from any hazardous activity conducted by the Company or any Party. JEA will be entitled to control any remedial action, any proceeding relating to an environmental claim. This indemnification agreement is separate and apart from, and is in no way limited by, any insurance provided pursuant to this Contract or otherwise. This section relating to indemnification shall survive the Term of this Contract, and any holdover and/or Contract extensions thereto, whether such Term expires naturally by the passage of time or is terminated earlier pursuant to the provisions of this Contract.

2.7.4. TITLE AND RISK OF LOSS

Ownership, risks of damage to or loss of the Work shall pass to JEA upon Acceptance. The Company shall assume all risk of loss or damage to the Work while items are in transit and/or in the Company's custody until such time that JEA issues written notice of Acceptance.

JEA's receipt or delivery of any equipment or other materials will not constitute JEA's Acceptance of the Work and will not constitute a waiver by JEA of any right, claim or remedy. In the event of loss or damage to the Work, the Company shall bear all costs associated with any loss or damage until Acceptance by JEA.

For equipment and materials removed from JEA sites or the Work locations for repairs, service or duplication, JEA will retain the title to equipment and materials removed.

2.7.5. BOND AMOUNT

The Company shall furnish a Payment Bond and Performance Bond in the amount of indicated on the Bid Form, made out to JEA in forms and formats approved and provided by JEA, as security for the faithful performance of the Work of Contract. JEA will send the approved bond forms to the Company for execution along with the Contract, however, in no case shall the date on the bond forms be prior to that of the executed Contract. The surety must be authorized and licensed to transact business in Florida. A fully executed Payment Bond and Performance Bond must be recorded with the Clerk of Duval County Court and delivered to JEA before JEA will issue a Purchase Order to begin the Work. No Purchase Order shall be issued until the Payment and Performance Bonds are recorded and delivered to the JEA Procurement Department. If the Company fails or refuses to furnish or record the required bonds, JEA will retain the Company's Bid Bond as liquidated damages.

2.7.6. NOTIFICATION OF SURETY

The Company shall notify its surety of any changes affecting the general scope of the Work or altering the Contract Price. The amount of the applicable bonds shall be adjusted accordingly and the Company shall furnish proof of such adjustment to JEA within ten (10) days of date of Purchase Order.

2.8. ACCEPTANCE

2.8.1. DELAY IN ACCEPTANCE OR DELIVERY

JEA may delay delivery or acceptance of goods in the event of any unforeseen event. The Company shall hold the goods pending JEA's direction, and JEA will be liable only for direct increased costs incurred by the Company by reason of JEA's instructions.

2.8.2. ACCEPTANCE OF WORK - RECEIPT, INSPECTION, USAGE AND TESTING

The Contract Administrator will make the determination when Work is completed and there is Acceptance by JEA. Acceptance will be made by JEA only in writing, and after adequate time to ensure Work is performed in accordance with Contract Documents. JEA will reject any items delivered by Company that are not in accordance with the Contract, and shall not be deemed to have accepted any items until JEA has had reasonable time to inspect them following delivery or, if later, within a reasonable time after any latent defect in the items has become apparent. JEA may partially accept the Work items. If JEA elects to accept nonconforming items, it may in addition to other remedies, be entitled to deduct a reasonable amount from the price as compensation for the nonconformity. Any Acceptance by JEA, even if nonconditional, shall not be deemed a waiver, or settlement or acceptance of any Defect.

Items specifically required prior to Acceptance are: SEE TECHNICAL SPECIFICATIONS.

2.9. TERM AND TERMINATION

2.9.1. TERM

2.9.1.1. TERM OF CONTRACT - THROUGH COMPLETION OF WORK

The Contract shall be in force through completion of all Work, Acceptance and final payment, including resolution of all disputes, claims, or suits, if any. Certain provisions of this Contract may extend past termination including, but not limited to, Warranty and Indemnification provisions.

This Contract, after the initial year, shall be contingent upon the existence of lawfully appropriated funds for each subsequent year of the Contract.

2.9.2. TERMINATION FOR CONVENIENCE

JEA shall have the absolute right to terminate the Contract in whole or part, with or without cause, at any time after the Award effective date upon written notification of such termination.

In the event of termination for convenience, JEA will pay the Company for all disbursements and expenses that the Company has incurred, or has become obligated prior to receiving JEA's notice of termination.

Upon receipt of such notice of termination, the Company shall stop the performance of the Work hereunder except as may be necessary to carry out such termination and take any other action toward termination of the Work that JEA may reasonably request, including all reasonable efforts to provide for a prompt and efficient transition as directed by JEA.

JEA will have no liability to the Company for any cause whatsoever arising out of, or in connection with, termination including, but not limited to, lost profits, lost opportunities, resulting change in business condition, except as expressly stated within these Contract Documents.

2.9.3. SUSPENSION OF WORK

JEA may suspend the performance of the Work by providing the Company with five (5) days' written notice of such suspension. Schedules and compensation for performance of the Work shall be amended by mutual agreement to reflect such suspension. In the event of suspension of Work, the Company shall resume full performance of the Work when JEA gives written direction to do so. Suspension of Work for reasons other than the Company's negligence or failure to perform, shall not affect the Company's compensation as outlined in the Contract Documents.

2.9.4. TERMINATION FOR DEFAULT (WITH A BOND)

JEA may give the Company written notice to discontinue all or part of the Work under the Contract or a Notice to Cure a material breach in the event that:

- o The Company assigns or subcontracts the Work without prior written permission;
- o Any petition is filed or any proceeding is commenced by or against the Company for relief under any bankruptcy or insolvency laws;
- o A receiver is appointed for the Company's properties or the Company commits any act of insolvency (however evidenced);
- o The Company makes an assignment for the benefit of creditors;
- o The Company suspends the operation of a substantial portion of its business;

- o The Company suspends the whole or any part of the Work to the extent that it impacts the Company's ability to meet the Work schedule, or the Company abandons the whole or any part of the Work;
- o The Company, at any time, violates any of the conditions or provisions of the Contract Documents, or the Company fails to perform as specified in the Contract Documents, or the Company is not complying with the Contract Documents;
- o The Company attempts to willfully impose upon JEA items or workmanship that are, in JEA's sole opinion, defective or of unacceptable quality;
- o The Company breaches any of the representations or warranties;
- o The Company is determined, in JEA's sole opinion, to have misrepresented the utilization of funds or misappropriate property belonging to JEA; or
- o There is an adverse material change in the financial or business condition of the Company.

If within thirty (30) days after service of such notice to discontinue or notice to cure upon the Company an arrangement satisfactory to JEA has not been made by the Company for continuance of the Work or the material breach has not been remedied, JEA may declare the Company to be in default and terminate the Contract.

Once Company is declared in default and the Contract has been terminated, JEA will notify the Surety in writing of the termination. The Surety shall, at JEA's sole option take one (1) of the following actions:

- (a) Within a reasonable time, but in no event later than thirty (30) days, from JEA's written notice of termination for default, arrange for Company with JEA's consent, which shall not be unreasonably withheld, to complete the Contract and the Surety shall pay JEA all losses, delay and disruption damages and all other damages, expenses, costs and statutory attorney's fees, including appellate proceedings, that JEA sustains because of a default by the Company under the Contract;
- (b) Within a reasonable time, but in no event longer than sixty (60) days after JEA's written notice of termination for default, award a contract to a completion contractor and issue notice to proceed or alternatively, JEA may elect, to have the Surety determine jointly with JEA the lowest responsible qualified bidder, to have the Surety arrange for a contract between such bidder and JEA, and for the Surety to make available as Work progresses sufficient funds to pay the cost of completion less the balance of the Contract price; or
- (c) Within a reasonable time, but in no event later than thirty (30) days from JEA's notice of termination for default, JEA may waive its right to complete or arrange for completion of the Contract and, within twenty-one (21) days thereafter, determine the amount for which the Surety may be liable to JEA and tender payment to JEA of any amount necessary in order for JEA to complete performance of the Contract in accordance with its terms and conditions less the balance of the Contract price.

JEA shall have the right to take possession of and use any of the materials, plant, tools, equipment, supplies and property of any kind provided by the Company for the purpose of this Work.

JEA will charge the expense of completing the Work to the Company and will deduct such expenses from monies due, or which at any time thereafter may become due, to the Company. If such expenses are more than the sum that would otherwise have been payable under the Contract, then the Company or Surety shall pay the amount of such excess to JEA upon notice of the expenses from JEA. JEA shall not be required to obtain the lowest price for completing the Work under the Contract, but may make such expenditures that, in its sole judgment, shall best accomplish such completion. JEA will, however, make reasonable efforts to mitigate the excess costs of completing the Work.

The Contract Documents shall in no way limit JEA's right to all remedies for nonperformance provided under law or in equity, except as specifically set forth herein. In the event of termination for nonperformance, the Company shall immediately surrender all Work records to JEA. In such a case, JEA may set off any money owed to the Company against any liabilities resulting from the Company's nonperformance.

JEA has no responsibility whatsoever to issue notices of any kind, including but not limited to deficient performance letters and scorecards, to the Company regarding its performance prior to default by Company for performance related issues.

JEA shall have no liability to the Company for termination costs arising out of the Contract, or any of the Company's subcontracts, as a result of termination for default.

Immediately upon termination or expiration of this Agreement, Company must return to JEA all materials, documents and things used by Company and belonging to JEA, including proposals, computer files, borrower files, building keys, and any other property or information regarding continued business compliance or goodwill, whether in electronic or hard-copy form. Furthermore, upon JEA's request, Company shall certify in writing that all of the foregoing documents or materials, including archival or backup copies, whether in electronic or hard-copy form, have been returned to JEA, deleted from any computer system, or otherwise destroyed.

Any other provision in this Agreement to the contrary notwithstanding the duration of this Agreement after the initial year, shall be contingent upon the existence of lawfully appropriated funds for each subsequent year of the term.

2.9.5. UNAUTHORIZED WORK

JEA will consider any Work done without lines and grades given, Work done beyond the lines and grades shown on the Contract or as given, or any extra Work done without written authority, as unauthorized Work and will not pay the Company for such Work. If so ordered by the Contract Administrator, the Company shall remove such Work and properly replace it at the Company's own expense.

2.10. PRELIMINARY MATTERS

2.10.1. MAINTENANCE OF TRAFFIC

The Company, when required by the governing agency such as the City of Jacksonville or the Florida Department of Transportation (FDOT), shall maintain traffic in accordance with an approved Maintenance of Traffic (MOT) plan ("MOT Plan") submitted by the Company, on streets, roads, private ways, and walks. The Company shall assume full responsibility for the adequacy and safety of provisions made. The Company shall be solely responsible for the placement, maintenance and removal of the minimum number of devices required by the MOT Plan, or specified by the FDOT, for the control of traffic at the Work Location including, but not limited to signs, cones, lights, barricades, concrete barrier walls, police officers, flaggers, etc. ("MOT Items").

Company shall be responsible for all costs associated with MOT. There will not be a separate line item for MOT on the Bid Form.

2.10.2. LIMITATION OF ACCURACY OF INFORMATIONAL MATERIALS

For all drawings, test results, inspections, and other informational materials included as part of the Contract Documents, the Company understands and agrees that any existing facilities shown, including underground, overhead, and surface structures, and other delineations, and any other informational items provided as part of the Contract Documents are for reference only and are not to be used by the Company as the only indication of Work conditions. The Company understands and agrees that it is its sole responsibility to verify all Work conditions,

measurements, dimensions, obstructions and other causes for existing or potential changes to the Work prior to initiating Work. In the event the Work must be changed due to the Company not fulfilling the above requirements, the Company understands and agrees that it will be responsible for all costs associated with the changed condition. Changes associated with conditions that are clearly unforeseen and that could not have been discovered by a reasonable verification of the above listed items, shall be covered as stated in Changes to Work.

2.10.3. PERMITS TO BE OBTAINED BY THE CONTRACTOR

Unless otherwise specified in the Contract Documents, the Contractor shall secure, maintain, post as required, and pay for all building, plumbing, electrical, water, sewer, right-of-way, parking, roadway, railroad, shipping, freight, hazardous materials, and any other permits which may be required for performance of the Work in full compliance with all applicable laws, rules and regulations. The Contractor shall perform all actions necessary to identify where permits are to be obtained and properly file for the permits, except those specifically listed in the Contract Documents as being provided by JEA.

The Contractor shall comply with all conditions of permits issued for the Work, either directly or indirectly, issued by federal, state, or local governmental agencies, which are hereby incorporated as part of these Contract Documents. The Contractor shall be solely responsible for resolving any issues and bearing all expenses including any damages suffered by JEA that result from a finding of noncompliance during performance of the Work by any of the respective regulatory agencies including, but not limited to, all costs for delays, litigation, fines, fees of any kind, and other costs.

2.10.4. PRE-WORK MEETING AND PROGRESS MEETINGS (CONSTRUCTION)

Before starting the Field Work, a Pre-Work or Pre-Construction meeting may be held to review procedures for the Work, review the Work schedule, establish procedures for invoicing, approving Invoices and making payments, and establish a working relationship between JEA and the Company.

The JEA Contract Administrator may, at his or her discretion, request Pre-Work Meetings to be held prior to start of any Field Work. Such meeting(s) shall be attended by, but not limited to, the Company Representative and Company Supervisor. The JEA Contract Administrator will notify the Company in writing of the meeting time and location at least two (2) days prior to the meeting date. In addition, construction progress meetings will be held at a frequency as determined by JEA. Such meeting(s) shall be attended by, but not limited to, the Company's Representative and Company's Supervisor.

2.10.5. TEMPORARY CLOSURE OF ROADWAYS

The Company shall not close or obstruct any portion of a street, road, or private way without first obtaining permits. If any street or private way is rendered unsafe by the Company's operations, the Company shall make such repairs or provide such temporary ways and guards necessary for the protection and safety of persons on the Work and the public and for the orderly maintenance of traffic. All costs associated with temporary closure of roadways shall be included in Bid Price.

The Company shall notify the police and fire departments in writing if it will be necessary to close a street. The Company shall copy JEA on all correspondence relating to street closure. The Company shall notify the police and fire departments prior to closure of the street. The Company shall be responsible for maintaining proper coordination with the proper authorities.

Temporary closure of business entrances must be approved in writing by and coordinated with JEA.

2.10.6. TEMPORARY UTILITIES

The Company shall furnish and install all temporary water, electricity and other utilities required to accomplish the Work. The Company shall obtain the water required for carrying out the Work from fire hydrants, existing water main connections, or new connections approved by JEA. The Company shall install a back flow preventer and water meter assembly if construction water is necessary. Upon Substantial Completion of Work, the Company shall remove all evidence of temporary connections and lines.

Prior to initiating any construction Work, the Company shall coordinate and schedule the provision of temporary utility service required during construction and arrange for the permanent installation and connection of utilities for the completed Work.

2.10.7. WORK LOCATION

Work shall be performed at the following location(s): GREENLAND ENERGY CENTER

2.10.8. UNFORESEEN CONDITIONS

The Company understands and agrees that it is its responsibility to conduct due diligence prior to the Work. Such due diligence includes, but is not limited to, verifying all Work conditions, measurements, dimensions and latent and patent obstructions, the accuracy of drawings, test results, inspections and other informational materials provided in the Contract Documents, and any other causes for existing or potential changes to the Work prior to initiating the Work. In the event that the Work must be changed due to the Company's failure to fulfill the above requirements, the Company understands and agrees that it will be responsible for all costs associated with the changed condition.

In the event, however, that the Company exercises the requisite due diligence and a change to the Work becomes necessary resulting from conditions that are clearly unforeseen and that could not have been discovered, the costs for adjusting the Work in response to such unforeseen conditions shall be addressed in a Change Order or an amendment to the Contract executed by JEA and Company. Any Work the Company performs prior to receipt of such Change Order or approved Contract amendment will be at the Company's sole risk.

2.10.9. COMMERCIAL ACTIVITIES ON THE WORK LOCATION

The Company shall not establish any commercial activities, or issue concessions or permits of any kind to third parties to establish commercial activities on lands owned or controlled by JEA, or within the boundaries of the Work Location. The Company shall not allow its employees to engage in any commercial activities on the Work Location.

2.10.10. COMPLETION OF WORK

The Company shall begin Work within ten (10) days after the date of written Notice to Proceed from JEA to begin Work, and shall complete the Work by the date set forth in the Contract Documents. The Company further understands and agrees that time is of essence and should the Company fail to complete the Work on or before the date established for Substantial Completion and Final Acceptance, the Company shall be solely responsible for additional costs as defined in the Contract.

2.10.11. COMPANY LAYDOWN AREA

In the event the Company decides to utilize public or private property as a laydown area, the Company shall enter into a written agreement with the entity who owns the property. JEA shall have access to all laydown areas. Upon submission of Company's first Invoice or application for payment to JEA, the Company shall provide to JEA a copy of such signed written agreement. The Company shall submit to JEA a letter of release from the entity in connection with Company's final Invoice or application for payment to JEA.

2.10.12. COMPANY REPRESENTATIVE

The Company shall provide JEA with the name and responsibilities of the Company Representative, in writing after Award of the Contract and before starting the Work under the Contract. Should the Company need to change the Company Representative, the Company shall promptly notify JEA in writing of the change.

2.10.13. COMPANY'S DOCUMENTS AT THE WORK LOCATION

The Company shall maintain at the Work Location for JEA one (1) record copy of all Contract Documents in good order and marked currently to record all Addenda and changes made during Contract Term. These shall be available to JEA Representatives and shall be delivered to the Contract Administrator upon completion of the Work and at the request of the Contract Administrator.

The Company shall also maintain detailed records of the Work for its own files. The Company shall make these records available to JEA for inspection upon request. The Company shall maintain such records for three years after date of Final Completion.

2.10.14. COMPANY'S FIELD OFFICE

The Company shall provide its own office facilities at the Work Location, as required. Unless specifically listed herein, JEA provides no Work Location facilities or Work Location area for the Company facilities of any kind such as field office and material storage. If the Company establishes a Work Location-based office, the Company shall provide and maintain adequate telephone facilities at this office during the full Term of the Contract. If the Company has a local business office, this office may serve as a Work Location office for this Contract, but the Company must maintain an operational cellular phone at the Work Location while performing Work.

2.11. CONFIDENTIALITY AND OWNERSHIP OF DOCUMENTATION

2.11.1. PUBLIC RECORDS LAWS

Access to Public Records

All Documents, data and other records received by JEA in connection with the Contract are public records and available for public inspection unless specifically exempt by law. The Company shall allow public access to all documents, data and other records made or received by the Company in connection with the Contract unless the records are exempt from Section 249(a) of Article I of the Florida Constitution or subsection 119.07(1), Florida Statutes. JEA may unilaterally terminate the Contract if the Company refuses to allow public access as required under the Contract.

Redacted copies of Confidential Information

If the Company believes that any portion of any documents, data or other records submitted to JEA are exempt from disclosure under Chapter 119, Florida Statutes, the Florida Constitution and related laws ("Florida's Public Records Laws"), Company must (1) clearly segregate and mark the specific sections of the document, data and records as "Confidential", (2) cite the specific Florida Statute or other legal authority for the asserted exemption, and (3) provide JEA with a separate redacted copy of the documents, data, or records (the "Redacted Copy"). The Redacted Copy shall contain JEA's contract name and number, and shall be clearly titled "Redacted Copy". Bidder should only redact those portions of records that Bidder claims are specifically exempt from disclosure under Florida's Public Records Laws. If the Company fails to submit a redacted copy of documents, data, or other records it claims is confidential, JEA is authorized to produce all documents, data, and other records submitted to JEA in answer to a public records request for these records.

Request for Redacted Information

In the event of a public records or other disclosure request under Florida's Public Records Laws or other authority to which the Company's documents, data or records are responsive, JEA will provide the Redacted Copy to the requestor. If a Requestor asserts a right to any redacted information, JEA will notify the Company that such an assertion has been made. It is the Company's responsibility to respond to the requestor to assert that the information in questions is exempt from disclosure under applicable law. If JEA becomes subject to a demand for discovery or disclosure of the redacted information under legal process, JEA shall give the Company prompt notice of the demand prior to releasing the redacted information (unless otherwise prohibited by applicable law). The Company shall be responsible for defending its determination that the redacted portions of the information are not subject to disclosure.

Indemnification for Redacted Information

The Company shall protect, defend, and indemnify JEA from and against all claims, demands, actions, suits, damages, liabilities, losses, settlements, judgments, costs, and expenses (including but not limited to reasonable attorney's fees and costs) arising from or relating to the Company's assertion that all or any portion of its information is not subject to disclosure.

Public Records Clause for Service Contracts

If, under the Contract, the Company is providing services and is acting on behalf of JEA as contemplated by subsection 119.011(2), Florida Statutes, the Company shall:

- Keep and maintain public records that ordinarily and necessarily would be required by JEA in order to perform service;
- Provide the public with access to public records on the same terms and conditions that JEA would provide the records and at a cost that does not exceed the cost provided in Chapter 119, Florida Statutes, or otherwise prohibited by law;
- Ensure that public records that are exempt or confidential and exempt from public records disclosure requirements are not disclosed except as authorized by law; and
- Meet all requirements for retaining public records and transfer, at no cost, to JEA all public records in possession of the Company 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 shall be provided to JEA in a format that is compatible with the information technology systems of JEA.

IF THE COMPANY HAS QUESTIONS REGARDING THE APPLICATION OF CHAPTER 119, FLORIDA STATUTES, TO THE COMPANY'S DUTY TO PROVIDE PUBLIC RECORDS RELATING TO THIS CONTRACT, CONTACT THE CUSTODIAN OF PUBLIC RECORDS AT:

JEA

Attn: Public Records

21 West Church Street

Jacksonville, Florida 32202

Ph: 904-665-8606

publicrecords@jea.com

2.11.2. INTELLECTUAL PROPERTY

The Company grants to JEA an irrevocable, perpetual, royalty free and fully paid-up right to use (and such right includes, without limitation, a right to copy, modify and create derivative works from the subject matter of the grant of the right to sublicense all, or any portion of, the foregoing rights to an affiliate or a third party service provider) the Company's intellectual property (including, without limitation, all trade secrets, patents, copyright and know-how) that is contained or embedded in, required for the use of, that was used in the production of or is required for the reproduction, modification, maintenance, servicing, improvement or continued operation of any applicable unit of Work.

If the Work contains, has embedded in, requires for the use of any third party intellectual property, or if the third party intellectual property is required for the reproduction, modification, maintenance, servicing, improvement or continued operation of the Work, the Company shall secure for JEA an irrevocable, perpetual, royalty free and fully paid-up right to use all third party intellectual property. The Company shall secure such right at its expense and prior to incorporating any third party intellectual property (including, without limitation, all trade secrets, patents, copyright and know-how) into any Work, including, without limitation, all drawings or data provided under the Contract, and such right must include, without limitation, a right to copy, modify and create derivative works from the subject matter of the grant of the right and a right to sublicense all or any portion of the foregoing rights to an affiliate or a third party service provider.

Should JEA, or any third party obtaining such work product through JEA, use the Work or any part thereof for any purpose other than that which is specified herein, it shall be at JEA's sole risk.

The Company will, at its expense, defend all claims, actions or proceedings against JEA based on any allegation that the Work, or any part of the Work, constitutes an infringement of any patent or any other intellectual property right, and will pay to JEA all costs, damages, charges, and expenses occasioned to JEA by reason thereof. JEA will give the Company written notice of any such claim, action or proceeding and, at the request and expense of the Company, JEA will provide the Company with available information, assistance and authority for the defense.

If, in any action or proceeding, the Work, or any part thereof, is held to constitute an infringement, the Company will, within thirty (30) days of notice, either secure for JEA the right to continue using the Work or will, at the Company's expense, replace the infringing items with noninfringing Work or make modifications as necessary so that the Work no longer infringes.

The Company will obtain and pay for all patent and other intellectual property royalties and license fees required in respect of the Work.

2.11.3. PROPRIETARY INFORMATION

The Company shall not copy, reproduce, or disclose to third parties, except in connection with the Work, any information that JEA furnishes to the Company. The Company shall insert in any subcontract a restriction on the use of all information furnished by JEA. The Company shall not use this information on another project. All information furnished by JEA will be returned to JEA upon completion of the Work.

2.11.4. PUBLICITY AND ADVERTISING

The Company shall not take any photographs, make any announcements or release any information concerning the Contract or the Work to any member of the public, press or official body unless prior written consent is obtained from JEA.

2.12. LABOR

2.12.1. NONDISCRIMINATION

The Company represents that it has adopted and will maintain a policy of nondiscrimination against employees or applicants for employment on account of race, religion, sex, color, national origin, age or handicap, in all areas of employee relations, throughout the Term of this Contract. The Company agrees that on written request, it will allow JEA reasonable access to the Company's records of employment, employment advertisement, application forms and other pertinent data and records for the purpose of investigation to ascertain compliance with the nondiscrimination provisions of this Contract; provided however, the Company shall not be required to produce, for inspection, records covering periods of time more than one (1) year from the effective date of this Contract.

The Company shall comply with the following executive orders, acts, and all rules and regulations implementing said orders or acts, which are by this reference incorporated herein as if set out in their entirety:

- The provisions of Presidential Order 11246, as amended, and the portions of Executive Orders 11701 and 11758 as applicable to Equal Employment Opportunity;
- The provisions of section 503 of the Rehabilitation Act of 1973, as amended, and the Americans with Disabilities Act (ADA); and
- The provisions of the Employment and Training of Veterans Act, 38 U.S.C. 4212 (formerly 2012).

The Company agrees that if any of the Work of this Contract will be performed by a Subcontractor, then the provisions of this subsection shall be incorporated into and become a part of the subcontract.

2.12.2. JEA ACCESS BADGES

If the scope of work described in this Contract requires a Company to access JEA facilities, each Company employee shall apply for a JEA access badge through JEA's Security Department. An appointment to obtain a JEA access badge can be made by contacting JEA Security at securitybadge@jea.com. Finally, JEA does not allow Company employees to share JEA access badges. A Company whose employees are found to be sharing JEA access badges, will result in the Contract being terminated immediately for default. Additionally, JEA shall be notified within six (6) hours of a lost or stolen JEA security badge or when an employee leaves the Company. Report badge termination notifications to JEA Security at (904) 665-8200.

2.12.3. LEGAL WORKFORCE

JEA shall consider the Company's employment of unauthorized aliens a violation of section 274A(e) of the Immigration and Nationalization Act. Such violation shall be cause for termination of the Contract for default upon thirty (30) days' prior written notice of such termination, notwithstanding any other provisions to the contrary in the Contract Documents.

2.12.4. JEA WORKPLACE TOBACCO USE POLICY

It is JEA's policy to maintain a healthy work environment and JEA's goal is to become a tobacco-free workplace. Therefore, JEA prohibits Company employees from using tobacco products while on JEA property or during the performance of JEA Work. JEA reserves the right to require Company to remove an employee who violates this policy from JEA property or JEA Work site upon notice from the JEA Representative.

2.12.5. PROHIBITED FUTURE EMPLOYMENT

It shall be unlawful and a class C offense for any person, who was an officer or employee of JEA, after his or her employment has ceased, to be employed by or enter into any contract for personal services, with a person or company who contracted with, or had a contractual relationship with JEA, while the contract is active or being

completed, or within two (2) years of the cessation, completion, or termination of the person's or company's contractual relationship with JEA, where (1) the contract with JEA had a value that exceeded \$250,000.00, and (2) the officer or employee had a substantial and decision-making role in securing or negotiating the contract or contractual relationship, or in the approval of financial submissions or draws in accordance with the terms of the contract; except that this prohibition shall not apply to an employee whose role is merely as a review signatory, or to contracts entered into prior to January 1, 2008, or to contracts that have been competitively procured. With respect to this subsection a contract is competitively procured if it has been obtained through a sealed low bid award. A "substantial and decision-making role" shall include duties and/or responsibilities that are collectively associated with: (i) approving solicitation or payment documents; (ii) evaluating formal bids and proposals; and (iii) approving and/or issuing award recommendations for JEA Awards Committee approval. The contract of any person or business entity who hires or contracts for services with any officer or employee prohibited from entering into said relationship shall be voidable at the pleasure of JEA. This prohibition shall not apply to any former officer or employee after two (2) years from cessation from JEA employment.

2.12.6. HIRING OF OTHER PARTY'S EMPLOYEES

Each party recognizes that the other party has incurred or will incur significant expenses in training its own employees and agrees that it will not pursue or hire, without the other party's consent, the other party's employees or the employees of its subsidiaries for a period of two (2) years from the termination date of this Contract.

2.12.7. MINIMUM QUALIFICATION OF COMPANY PERSONNEL

At a minimum, all Company personnel shall be qualified for the tasks they are assigned. All Company personnel assigned to work at a JEA facility or job site shall be able to read, write, speak and understand English. All Company personnel shall act in a professional manner, with due sensitivity to other persons at the Work Location. If JEA, at its sole discretion, determines that a Company person is unqualified, unfit, or otherwise unsuitable for the tasks assigned, the Company shall immediately stop the person from performing the tasks, and replace the person with a qualified individual. The Company shall pay all costs associated with replacing the unqualified person including, but not limited to, termination, recruiting, training, and certification costs.

The Company personnel assigned supervisory roles, and those with increased authority shall be held to strict scrutiny of their qualifications and suitability for their positions. In addition to the other provisions of this Section, the Company shall provide written documentation as to experience, education, licenses, certifications, professional affiliations, and other qualifications of the individual, within one (1) day of request from the Contract Administrator. Any changes to such personnel after approval shall require the written permission of the Contract Administrator.

2.12.8. PAYMENT OF OVERTIME

Any Overtime required for Company to complete the Work within the Contract Time shall be at the sole cost and expense of Company. However, if JEA requires the Company to perform Overtime Work in order to complete the Work prior to the Contract Time, the Company shall bill JEA for the Overtime such that only the actual costs incurred by the Company relating to the payment of Overtime premiums, in accordance with its labor policies and applicable laws. Such actual costs include Overtime wage premium, and additional taxes and insurance directly associated with the Overtime wage premium. The Company agrees that it will not charge for personnel paid a salary, or other form of compensation such that the Company incurs no direct costs as a result of the Overtime.

The Company shall total the direct Overtime charges, and add the agreed upon overhead rate, but in no case, shall such overhead rate exceed ten percent (10%) of the total overtime costs.

Overtime may only be charged to JEA if the Company was directed in writing by the Contract Administrator to incur the Overtime. Such authorization for Overtime shall be accompanied by a Change Order.

2.12.9. SCHEDULING OF OVERTIME

Whenever the Company schedules Work beyond eight (8) hours per day for a five (5) day week, beyond ten (10) hours per day for a four (4) day week, beyond forty (40) hours per week, or on Saturdays, Sundays, or Holidays, then the Company shall arrange, in advance, for the JEA Representative to inspect the Work performed during Overtime. The Company shall not perform Overtime Work or after-hours Work without a JEA Representative at the Work Location or available to perform the inspections, as directed by the Contract Administrator. Except where JEA has requested the Company schedule Overtime to perform additional Work, the Company shall reimburse JEA for any additional costs associated with JEA Representatives' Overtime pay.

2.12.10. SHOW-UP PAY

In the event that inclement weather prevents the Company from performing Work, the Company may be obligated to pay its crew a show-up pay. The Company shall be solely responsible for providing this pay.

2.12.11. COMPANY'S LABOR RELATIONS

The Company shall negotiate and resolve any disputes between the Company and its employees, or anyone representing its employees. The Company shall immediately notify JEA of any actual or potential labor dispute that may affect the Work and shall inform JEA of all actions it is taking to resolve the dispute.

2.13. COMPANY'S RESPONSIBILITIES AND PERFORMANCE OF THE CONTRACT

2.13.1. COMPANY REPRESENTATIVES

The Company shall provide JEA with the name and responsibilities of the Company Representative, in writing after Award of the Contract and before starting the Work under the Contract. Should the Company need to change the Company Representative, the Company shall promptly notify JEA in writing of the change.

2.13.2. COMPANY REVIEW OF PROJECT REQUIREMENTS

The Company shall review the Work requirements and specifications prior to commencing Work. The Company shall immediately notify the Contract Administrator in writing of any conflict with applicable law, or any error, inconsistency or omission it may discover. JEA will promptly review the alleged conflicts, errors, inconsistencies or omissions, and issue a Change Order or Purchase Order as appropriate if JEA is in agreement with the alleged conflict, and issue revised specifications. Any Work the Company performs prior to receipt of approved Change Order will be at the Company's sole risk.

2.13.3. LICENSES

The Company shall comply with all licensing, registration and/or certification requirements pursuant to applicable laws, rules and regulations. The Company shall secure all licenses, registrations and certifications as required for the performance of the Work and shall pay all fees associated with securing them. The Company shall produce written evidence of licenses and other certifications immediately upon request from JEA.

2.13.4. PERFORMANCE OF THE WORK

The Company represents and warrants that it has the full corporate right, power and authority to enter into the Contract and to perform the acts required of it hereunder, and that the performance of its obligations and duties hereunder does not and will not violate any Contract to which the Company is a party or by which it is otherwise bound. The Company warrants that all items provided under the Contract shall be free from Defect and services shall be performed in a professional manner and with professional diligence and skill, consistent with the prevailing standards of the industry. The Company warrants that the Work will meet the functional and performance requirements defined in the Contract.

2.13.5. DAMAGED MATERIALS OR EQUIPMENT

The Company shall report to the Contract Administrator any materials issued by JEA or delivered by the JEA material supplier and received by the Company that are later found to be faulty, damaged or discrepant in some manner. The Contract Administrator will obtain appropriate replacement materials upon written notification from the Contract Administrator. The Company shall not, under any circumstances, make a material replacement without written approval of the Contract Administrator.

The Company understands and agrees that damage to material and discrepancy of material is an expected part of performing the Work, and as such, the Company agrees it shall be solely responsible for any additional costs incurred as a result of damaged or discrepant materials, including, but not limited to, the costs to keep or get the Work on the Approved Schedule.

JEA will bill the Company for materials or equipment that are damaged while in the Company's custody. In such a case, the Company shall be charged the current JEA cost plus an inventory handling fee.

2.13.6. DELIVERY LOCATION

The delivery address for items provided under this Contract is: GREENLAND ENERGY CENTER, 12121 PHILLIPS HWY, JACKSONVILLE, FL 32258.

2.13.7. EMERGENCY PROCEDURES

In emergencies affecting the safety of persons, the Work or property at the Work Location or any other area adjacent thereto, the Company, without special instructions or authorization from JEA Representatives, is obligated to act to its best ability to prevent threatened damage, injury or loss to the Work, any persons, or property. The Company shall give the Contract Administrator prompt written notice describing the emergency, its cause, actions taken, injuries and casualties, property damage, other damages, and impact on continued performance under this Contract.

2.13.8. LAW ENFORCEMENT/SECURITY

Onsite law enforcement shall be provided by the Company to ensure safe working conditions for site personnel. Any work activities performed at night shall have onsite law enforcement present. Company shall submit with corresponding pay application verification of the number of hours of law enforcement utilized during each pay period, including any associated fees. Company agrees to invoice JEA for law enforcement at its cost with no markup.

2.13.9. ENCROACHMENTS ON RIGHTS OR PROPERTY

The Company shall be solely responsible for any encroachments on public property or on the rights or property of adjoining property owners to the Work Location, and shall hold JEA harmless because of any encroachments that may result because of the Company's improper layout. In this regard, the Company shall, without extra cost to JEA, remove any Work or portion of any Work that encroaches on the property other than that of the Work Location, or that is built beyond legal building or setback limits. The Company shall rebuild the affected Work or portion of Work at the proper location and in full compliance with the Contract Documents.

2.13.10. REMOVAL OF WORK

The Company shall not sell, assign, mortgage, hypothecate or remove Work that has been delivered to or installed at the Work Location.

2.13.11. FREE AND CLEAR TITLE

The Company warrants that it has title to all equipment and materials furnished under the Contract where title will pass to JEA, and that the equipment and materials passed to JEA are free and clear of all liens, claims, security interests and encumbrances.

2.13.12. INSPECTIONS AND TESTING

JEA, or its designated representatives, will perform inspections at the Company facilities during normal business hours and in a manner that minimizes disruption to the normal day-to-day work activities of the Company. Company shall provide safe and proper facilities for inspection access and observation of the Work and also for any inspection or testing by others.

If the Company has covered or concealed any Work from inspection in any way that the JEA Representative has not specifically requested prior to the JEA Representative's inspection, or if the JEA Representative considers it necessary or advisable that covered Work be inspected or tested by others, the Company, at the JEA Representative's request, shall uncover, expose or otherwise make available the portion of the Work in question for observation, inspection or testing as the JEA Representative may require. The Company shall furnish all necessary labor, material and equipment to make such Work available.

If such Work is defective, the Company shall bear all expenses of uncovering, exposure, observation, inspection and testing and of satisfactory reconstruction, including, but not limited to, compensation for additional professional services required by JEA, and no change in Contract Time will be considered as a result of the foregoing.

If such Work is not defective, JEA will reimburse the Company for actual time, material, and equipment costs for uncovering and reconstruction of the portion of the Work in question. JEA may also, at its sole discretion, grant the Company an extension of the Contract Time directly attributable to such uncovering, exposure, observation, inspection, testing and reconstruction.

All materials and equipment used in the construction of the Contract shall be subject to adequate inspection and testing in accordance with accepted standards. The Company shall select the laboratory or inspection agency for making all tests required by the specifications, and shall pay for this laboratory service direct, as a part of this Contract.

The Company shall pay for all required testing of materials and equipment. Two (2) copies of each test showing certification of each test shall be furnished to the JEA Engineer immediately after such test has been made and with the exception of concrete, prior to delivery of the materials or equipment tested to the Work Location. JEA will not accept the materials or equipment until tests have been approved.

Materials of construction, particularly those upon which the strength and durability of the structure may depend, shall be subject to inspection and testing to establish conformance with specifications and suitability for uses intended. Test requirements for all materials are set out in the detailed specifications for that particular material. All materials and equipment prior to being incorporated in the Work, and required by the JEA Engineer to be tested, shall be tested for conformance with contractual requirements. Standard items of a uniform nature may be accepted on the manufacturer's certification. Where specific performance and/or quality is referred to, it is the Company's responsibility to have the necessary tests performed by qualified persons to show that the contractual requirements are being met except those tests named in the Contract Documents to be performed by JEA. Certified test results shall be submitted promptly in quadruplicate to the JEA Engineer for review. All tests shall be performed in accordance with referenced standards. Where no reference is made, tests shall be performed in accordance with the methods prescribed by the American Society for Testing and Materials or such other organization as would be applicable.

The Company shall pay for any retests resulting from its failure to provide Work that passes required tests.

The JEA Engineer may appoint JEA Inspectors to inspect any and all materials and Work. Such inspection may extend to any or all parts of the Work and to the preparation and manufacture of the materials to be used. The JEA Inspectors shall not be authorized to alter, revoke, enlarge or relax the provisions of the Contract, nor will they be authorized to approve or accept any portion of the completed Work, nor to issue instructions contrary to the Contract. The JEA Inspector shall inform the JEA Engineer of the progress of the Work and the manner in which it is being done, and notify the Company of any infringement upon the Contract Documents. The JEA Inspector will have the authority to reject defective materials or to suspend any Work that is being improperly done subject to the final decision of the JEA Engineer.

2.13.13. INTERFERENCE WITH EXISTING UTILITIES

The Company acknowledges and agrees that there is a possibility that existing JEA or other utility facilities may cross and/or lie parallel to excavations in the area where Work will occur. Although JEA may indicate recorded obstacles on the drawings, it does not warrant that other subsurface obstacles do not exist. The Company shall be responsible for verifying the data furnished by JEA and for fully investigating and locating additional obstructions including every type below, on or above the ground. The Company should regard these impediments as normal to construction. All costs for performing such work shall not be paid for separately, but shall be included in the Company's costs on the Bid Document.

The Company shall comply with all requirements of the Sunshine State One-Call program.

In the event the Company encounters an unidentified utility during performance of the Work, the Company shall promptly cease Work in the affected area and shall immediately notify the JEA Representative in writing. JEA will investigate the area and propose remedial actions in accordance with the provisions stated herein in "Changes to the Work".

The Company shall work in cooperation with JEA and representatives of existing utilities to plan and coordinate putting new Work into service so as not to interfere with the operation of the existing utilities. Such plans shall be adhered to unless deviations therefrom are expressly permitted in writing by the Contract Administrator.

The Company shall at all times conduct the Work in a manner that interferes as little as possible with the existing utilities. Any cables exposed during construction, whether energized or not, must be handled and protected as if they are energized. The Company shall so conduct its operations and maintain the Work in such condition that adequate drainage shall be in effect at all times. The Company shall not obstruct existing gutters, ditches and other runoff facilities. When working in the vicinity of overhead lines, the Company shall request line rubber protection from JEA at least ten (10) days in advance of performing the work.

The Company shall be solely responsible for any damages, interferences, and interruptions of service caused to any utility's assets and services including water, sewer, electric, telephone, gas, cable, and other utility services, that result from the Company's failure to fulfill the above stated requirements.

In the event the Company damages an existing utility, the Company shall immediately notify the property owner, the owner of the damaged utility and the JEA Representative. Should the damage cause an interruption of service, the Company shall be responsible for restoring service as soon as possible; however, the Company shall not make repairs, other than any required to restore safe conditions, without the approval of the property owner, or the owner of the damaged utility. The Company shall be responsible for coordinating any repair effort, and any associated

costs should the utility owner or a licensed repair contractor be required to make the repair. JEA reserves the right to deduct any unsettled claim amount from Company's invoices until such time as the claim is satisfactorily resolved.

2.13.14. INTERFERENCE WITH OTHER JEA WORK OR OTHER COMPANIES

The Company shall perform the Work in a manner that minimizes the interference with other JEA work, City of Jacksonville work, or with work performed by other companies. The Company shall coordinate the Work with other persons and companies employed by JEA. If a difference of opinion regarding scheduling or coordination of the Work arises between the Company and another JEA contractor(s) performing work at the Work Location, JEA may arbitrate the matter. In such cases where JEA makes a decision regarding the scheduling or coordination of the work, the Company agrees to fully abide by JEA's decision. Unless otherwise agreed in writing by JEA, JEA will not be responsible for additional costs.

Any claims arising against the Company from damages to other companies' work, equipment, machinery, tools or other property shall be settled directly between the Company and the other companies involved. JEA will not, in any way, be a party to arbitrating or mediating any such disputes, nor shall JEA be responsible for any costs associated with such disputes.

2.13.15. INTERFERENCE WITH RAILROADS

The Company shall not build across, into, over or under, either temporarily or permanently, any portion of a railway or railway right-of-way without first obtaining all required permits. If the Company's operations render any railroad unsafe, the Company shall immediately notify the Contract Administrator and the railroad owner and take appropriate actions and such temporary safeguards as required to protect life, limb, and property, and to maintain orderly traffic.

The Company shall procure all railroad permits required for the Work beyond those procured by JEA and the costs for such permits shall be included in the Bid Documents. All costs associated with railroad fees for railroad flagmen, watchouts, inspectors, supervisors, any additional training of Company's employees that is required by applicable laws, rules and regulations when performing Work in association with railways, any certifications required for successful completion of the Work and all other associated costs shall be included in the Bid Document.

2.13.16. MATERIAL DELIVERED TO COMPANY SITES

The Company shall be responsible for all unloading, handling and storage of Work-related materials at the Work Location. Where the Company is to use a JEA-designated supplier to deliver materials to the Work Location, JEA will provide the Company, upon request, with contact names and information, along with required material lead-times. The Company is solely responsible for taking into account required material lead-times when planning its performance of the Work, and for communication and coordination of materials delivered to the Work Location by JEA suppliers. The Company shall be responsible for any additional delivery costs charged by the JEA material supplier for any Company delays.

If, for any reason, the Company is unable to receive, unload, handle or store materials it has ordered or caused to be ordered, the Company shall be responsible for any and all additional costs incurred by JEA for unloading, handling, storing, or additional shipping costs. In such cases where JEA is receiving items when the Company is unable to, such receipt does not indicate JEA's Acceptance of items.

2.13.17. OBLIGATIONS OF THE COMPANY

The Company shall provide everything necessary to successfully complete the Work except the materials and services specifically stated in the Contract to be provided by JEA. No payments, other than those shown in the Bid Documents, will be made to the Company for performance of any requirements of the Contract Documents. The

Company shall perform all Work in accordance with the Contract Documents and the applicable JEA standards manuals, safety manuals, policies, accepted commercial work practices, local, state, and federal, rules regulations and laws which may be amended from time to time. The Company shall provide all permits, certifications, insurances, and bonds necessary or required by good practice, except where specifically stated in the Contract to be provided by JEA.

The Company's personnel shall perform all Work in a professional, efficient, and competent manner. The Company is obligated to provide personnel possessing the skills, certifications, licenses, training, tools, demeanor, motivation, and attitude to successfully complete the Work. The Company is obligated to remove individuals from performing Work under this Contract when the Company recognizes an individual to not be working in a manner consistent with the requirements of this Contract, or when JEA notifies the Company that JEA has determined an individual or group of individuals to not be working in a manner consistent with the requirements of this Contract. The Company is obligated to ensure that their officers and executives interact with JEA, JEA customers, whether direct or indirect customers of JEA, with the utmost level of professionalism and integrity.

In the event the Contractor chooses to use Subcontractors, the Contractor is obligated to provide Subcontractors possessing the skills, certifications, licenses, training, tools, demeanor, motivation and attitude to successfully perform the work for which they are subcontracted. The Contractor is obligated to remove Subcontractors from performing Work under this Contract when the Contractor recognizes that a Subcontractor is failing to work in a manner consistent with the requirements of this Contract, or when JEA notifies the Contractor that JEA has determined a Subcontractor is failing to work in a manner consistent with the requirements of this Contract.

The Contractor is obligated to ensure that sufficient supervision of the Work is provided. This includes ensuring that the Contractor Supervisor is at the Work Location when Work is being performed.

The Contractor shall bear sole responsibility for the efficiency, adequacy and safety of the performance of the Work, including temporary Work and facilities, until Acceptance. The Contractor shall be solely responsible for any loss or damage to materials, tools, labor, and equipment used during the performance of, or in connection with, the Work. Any JEA comments or approval regarding the Contractor's performance, materials, working force, or equipment will not relieve the Contractor of any responsibility.

2.13.18. PROTECTION OF COMPANY PROPERTY

The Company shall bear sole responsibility for the efficiency, adequacy and safety of the performance of the Work, including temporary Work and facilities, until Final Completion. The Company shall be solely responsible for any loss or damage to materials, labor, and equipment used during the performance of, or in connection with, the Work. Any JEA comments or approval regarding the Company's performance, materials, working force, or equipment will not relieve the Company of any responsibility for such loss.

2.13.19. PROTECTION OF EXISTING FACILITIES AND GROUNDS

The Company shall be responsible for protecting all the existing facilities including, but not limited to, buildings, lawns, landscaping, sprinkler systems, and pavements, both public and private, that are encountered during the performance of the Work. At all times, the Company shall cooperate with the owners of such facilities by arranging and performing the Work in and around such facilities in a manner that facilitates their preservation, relocation, and/or reconstruction. The Company shall be responsible for the full restoration or replacement if the Company damages such facilities during or resulting from performance of the Work.

The Company shall verify the existing dimensions and clearances before laying out the Work. When the Work involves the laying of utility lines across landscaped areas and grassed areas, which may include, but is not limited to, irrigation systems, streets, sidewalks, and other paved areas, the Company shall protect and preserve all trees,

shrubs, palms, landscaping, etc., and restore such areas and all paved areas to their original sound conditions using construction techniques and materials that are the same as existing including replacing plants and trees with those of similar size and age. In the case of planted areas, the Company shall maintain the restoration Work until positive growth has been acknowledged in writing by the Contract Administrator.

All costs for such restoration and replacement work shall be included in the associated lines on the Bid Documents.

The Company shall not (except upon written consent from the property owner and Contract Administrator) enter or occupy with workers, tools, equipment or vehicles any land outside the permitted easements, right-of-ways, JEA property or the City of Jacksonville property.

2.13.20. SAFETY AND PROTECTION PRECAUTIONS (CONSTRUCTION)

The Company shall comply with all applicable federal, state and local laws, ordinances, all JEA procedures and policies including, but not limited to, JEA's Contractor Safety Management Process (available at JEA.com), and orders of any public body having jurisdiction for the safety of persons or protection of property. The Company understands and agrees that a violation of any provision of this Section e is grounds for an immediate termination of the Contract for default, with no requirement for JEA to provide Company with advanced notice and opportunity to cure. Additionally, the Company shall be responsible for all JEA damages associated with such termination.

The Company shall only use those Subcontractors who have met JEA Safety Prequalification requirements in the JEA Contractor Safety Management Process. The Company shall ensure that Subcontractors and their personnel have all the necessary personal protective equipment and training needed to perform the Work safely.

The Company understands and agrees that JEA Representatives may stop Work at any time that JEA, at its sole discretion, considers the Company's Work to be unsafe or a risk to person or property, and to direct the Company to, at a minimum, perform as directed in such a way as to render the Work environment safe. The Company understands and agrees that it is responsible for paying all costs associated with providing a safe work environment including, but not limited to, any costs associated with any JEA directed safety improvements. The Company also understands and agrees that it is solely responsible for the safety of personnel and property associated with the Work, and that any actions taken by JEA to prevent harm to persons or damage to equipment does not, in any way, relieve the Company of this responsibility.

The Company Representative, or alternatively, the Company Supervisor, shall be designated as the Company's representative responsible for the prevention of accidents.

If the nature of the Work requires, the Company shall notify the police and fire departments as to its Work Location in order to ensure prompt response in an emergency.

2.13.21. SAFETY REPRESENTATION

The Company represents and warrants to JEA that it has the capacity to train and supervise its employees, Subcontractors and suppliers to ensure the Work complies with all safety requirements of the Contract Documents. The Company shall be responsible for executing the necessary safety training and supervision of its employees and Subcontractors, and acknowledges that JEA is not responsible for training or supervising the Company's employees, except when noted for the purpose of enforcing compliance with these safety requirements.

2.13.22. SALVAGE AND EXCESS MATERIALS AND EQUIPMENT PROVIDED BY JEA

The Company shall protect salvaged or salvageable equipment and material from loss and damage. The Company shall protect excess materials and equipment provided by JEA to the Company for use in the Work from loss and damage. The Company shall inventory, sort and return salvage and excess materials, and shall weigh conductors.

The Company shall return salvage and excess materials and equipment to the appropriate JEA Service Center accompanied by the Contractor Material Returns Form, in accordance with the JEA's inspector and the instructions and authorization of the JEA's storeroom foreman.

2.13.23. SHIPPING - FOB DESTINATION

Items are purchased F.O.B. destination. The Company shall ensure the following:

- Pack and mark the shipment to comply with the Contract Documents; or in the absence of specifications in the Contract Documents, prepare the shipment in conformance with carrier requirements;
- Prepare and distribute commercial bills of lading;
- Deliver the shipment in good order and condition to the point of delivery specified in the Contract;
- Be responsible for any loss of and/or damage to the goods occurring before receipt of the shipment by JEA Representative at the delivery point specified in the Contract;
- Be responsible for obtaining any permits required for transportation to the installation site;
- Furnish a delivery schedule and designate the mode of delivering carrier; and
- Pay and bear all charges to the specified point of delivery.

2.13.24. SHOP DRAWINGS

The Company shall promptly submit all required Shop Drawings in accordance with the provisions provided herein. JEA will not grant an extension of Contract Time due to the Company's failure to submit Shop Drawings in ample time to allow for checking, revisions, reviews, and approval.

A letter of transmittal and four copies of each shop drawing shall accompany each submittal. Shop drawings shall be forwarded to the JEA Engineer. Each drawing shall be listed separately on the letter. The Company shall also note distinctively on the transmittal letter any deviations that the Shop Drawings may have from the requirements of the Contract Documents.

The JEA Engineer's approval of Shop Drawings shall not be construed as a complete check, nor shall it relieve the Company from responsibility for any deficiency that may exist, or from any departures or deviations from the requirements of the Contract unless the Company has, in writing, called the JEA Engineer's attention to such deviations at the time of submission and obtained written approval for the deviation. The JEA Engineer's approval shall not relieve the Company from the responsibility for errors of any sort in Shop Drawings or schedules, nor from responsibility for proper fitting of the Work, nor from the necessity of furnishing any Work, materials, equipment or tools, required by the Contract Documents that may not be indicated on Shop Drawings when approved. The Company shall be solely responsible for all quantities and dimensions shown on the Shop Drawings. The Company shall not execute any Work until the JEA Engineer approves the Shop Drawings and a copy stamped "Approved" is at the Work Location. The Company shall, at no extra cost to JEA, make all changes and alterations whatsoever in Work performed or in subcontracts or orders placed prior to the approval of any and all Shop Drawings.

The Company shall allow a minimum of fourteen (14) days for the review of Shop Drawings. This shall be the period for new Shop Drawings and Shop Drawings that are revised and resubmitted.

As used herein, the term "manufactured" applies to standard units usually mass produced, and "fabricated" means items specifically assembled or made out of selected materials to meet individual design requirements. Shop drawings shall establish the actual details of all manufactured or fabricated items; indicate proper relation to adjoining Work; amplify design details of mechanical and electrical equipment in proper relation to physical spaces in the structure; and incorporate minor changes of design or construction to suit actual conditions.

Shop drawings shall be complete in every detail, properly identified with the Contract name, Contract and subsection number for identification of each item, and state the qualifications, departures or deviations from the Contract, if any. Shop drawings for each section of the Work shall be numbered consecutively and the numbering system shall be retained throughout all revisions. Each drawing shall have a clear space above the title block in the lower right-hand corner for the approval stamps of the Company and the JEA Engineer.

If the materials are not listed in JEA's Approved Materials Manual, then prior to purchase of material or fabrication, the Company shall forward to the JEA Engineer for review, five (5) sets of each shop drawing plus the number of prints it desires returned.

In checking the Shop Drawings, the Company shall verify all dimensions and field conditions and shall check and coordinate the Shop Drawings of any section or trade with the requirements of all other sections or trades whose Work is related thereto, as required for proper and complete installation of the Work. All rough-in and connections for utilities shall conform to approved equipment Shop Drawings.

The JEA Engineer will review the Shop Drawings and will return them to the Company stamped to indicate the action taken. The stamp will indicate that the shop drawing is "Approved", "Approved as Noted", "Returned for Correction", or "Disapproved". Only those Shop Drawings stamped "Returned for Correction" or "Disapproved" shall be resubmitted for subsequent review. Resubmittals shall be in the same form and number of copies as original submittals, with notation indicating a revised submittal. The Shop Drawings stamped "Approved" or "Approved as Noted" will be returned to the Company, who will be responsible for obtaining prints thereof and distributing them to the field and Subcontractors.

At the same time the JEA Engineer returns a reviewed submittal to the Company, it will forward two (2) copies of each item stamped "Approved" or "Approved as Noted" together with any conditions of approval, to JEA for field and office use. The JEA Engineer may revoke approval of Shop Drawings, should field conditions so dictate.

2.13.25. STORAGE

With the approval of the JEA Engineer, a limited amount of temporary indoor storage space may be made available, but only for the equipment that must be protected from the weather. Equipment for which arrangements have been made for indoor storage shall be packed separately and the container clearly marked "For Indoor Storage." For equipment that will be stored indoors and that will require special storage precautions, the storage instructions shall be shown on the outside of each container, or in a durable envelope identified as containing storage instructions and attached to the container.

2.13.26. STORAGE OF EQUIPMENT

The Company shall be responsible for all storage of materials, equipment, vehicles, tools, and all other items associated with the Work. Such storage shall comply with applicable regulations appropriate for the items being stored to ensure suitable care for items and protection from theft, vandalism, or inappropriate use. The Company is solely responsible for the costs for such storage, unless otherwise indicated in the Contract Documents, and any costs associated with noncompliant storage including, but not limited to, loss and damage to items. In the event that JEA directs the Company to stop the Work, costs associated with storing equipment or materials will be compensated in accordance with the Contract Documents. The Company shall ensure that JEA Representatives have access to Work-related storage on an as needed basis during regular work hours and Overtime.

2.13.27. STORM PREPAREDNESS

In the event of a Hurricane Warning, Tropical Storm Warning, or other large storm affecting the Work Location, the Company shall secure, or shall remove and store all equipment and materials at the Work Location including, but

not limited to, cones, barricades, lights and signs. The Company shall begin taking such precautions as necessary to secure the Work Location upon official issuance of mandatory evacuation of the area of the Work Location and no later than twenty-four (24) hours prior to predicted arrival of tropical storm or hurricane force winds, or when notified by a JEA Representative to do so. These activities are considered a regular part of the Work, regardless of the frequency they are required.

2.13.28. SUBSTITUTIONS

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.

Materials or equipment of other suppliers may be accepted by the JEA Engineer if sufficient information is submitted by the Company to allow the JEA Engineer to determine that the material or equipment proposed is equivalent or equal to that named.

The Company shall make written application to the JEA 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.

The application shall state that the evaluation and acceptance of the proposed substitute will not prejudice the Company's completion of the Work within the time prescribed by the Contract, whether or not acceptance of the substitute for use in the Work will require a change in any of the Contract Documents (or in the provisions of any other Contract directly with JEA for Work on the Contract) to adapt the design to the proposed substitute and whether or not incorporation or use of the substitute in connection with the Work is subject to payment of any license fees, royalties, permits or any other costs.

All variations of the proposed substitute from that specified shall be identified in the application and available maintenance, repair and replacement service shall be indicated.

The application shall also contain 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 Companies affected by the resulting change, all of which shall be considered by the JEA Engineer in evaluating the proposed substitute.

Requests for review of substitute items of material and equipment will not be accepted by the JEA Engineer from anyone other than the Company.

The JEA Engineer may require the Company to furnish, at the Company's expense, additional data about the proposed substitute.

If a specific means, method, technique, sequence or procedure of construction is indicated in or required by the Contract, the Company may furnish or utilize a substitute means, method, sequence, technique or procedure of construction acceptable to the JEA Engineer, if the Company submits sufficient information to allow the JEA Engineer to determine that the substitute proposed is equivalent to that indicated or required by the Contract.

The JEA Engineer will be allowed a reasonable time within which to evaluate each proposed substitute; such time shall not be deemed justification for an extension of the Company's time for completion of the Contract.

The JEA Engineer will be the sole judge of acceptability, and no substitute shall be ordered, installed or utilized without the JEA Engineer's prior written notice, which shall be evidenced by either a Change Order or an approved shop drawing.

JEA may require reimbursement for the costs associated with JEA's evaluation of substitutions.

JEA may require the Company to furnish, at the Company's expense, a special performance guarantee bonds or other surety with respect to any substitution.

2.13.29. QUALITY CONTROL AND QUALITY ASSURANCE

The Company shall provide Quality Control to ensure the Work is performed in accordance with the Contract. Quality Control shall be appropriate for the nature of the Work, and shall be conducted in a manner consistent with sound quality management and industrial engineering principles. The Company shall have only personnel trained in Quality Control techniques and experienced with the nature of the Work perform the Quality Control function.

JEA may perform Quality Assurance activities. Such activities, whether performed or not, do not in any way limit or reduce the Company's requirements. JEA may become aware of quality related problems during its performance of Quality Assurance, but has no obligation to notify the Company of its findings. The Company shall provide access to all areas of Work, including the Company's facilities, for JEA Quality Assurance personnel and JEA Representatives. JEA will conduct Quality Assurance activities so as not to excessively interfere with the Work, however, where JEA Quality Assurance personnel request specific actions of the Company, the Company shall comply with the request and agrees that such compliance is included as part of its Contract Price.

2.13.30. TOOLS AND EQUIPMENT

All tools and equipment used in the performance of the Work shall be used as intended by the manufacturer and in accordance with manufacturer operating manuals and industry practices, whichever is more stringent. The Company shall ensure that all tools and equipment used in the performance of the Work shall be of the size and quality suitable for safe and efficient performance of the Work. If the Company-provided tools and equipment do not meet these requirements, or if in the sole opinion of JEA formed after considering relevant factors, the tools or equipment are inappropriate for performance of the Work, the Company agrees to remove the unacceptable tools and equipment and obtain tools and equipment JEA considers suitable. Such replacement shall be entirely at the Company's expense, and no change to time prescribed by the Contract will be allowed.

The Company is responsible for furnishing and the security of any and all tools and equipment required to perform the Work.

2.13.31. CARE OF JEA CUSTOMERS

The Company agrees to provide excellent customer service throughout the execution of the Work during both scheduled Work hours and Overtime in the manner, as a minimum, as set forth below:

Customer Service Plan:

The Company shall submit a Customer Service Plan prior to mobilization and designate an individual to assume the duties of the Company's Customer Service Representative (CSR) as described herein.

The Company shall provide an after-hours emergency phone number to JEA.

The Company shall provide contact numbers for those individuals assigned to concerns arising during non-business hours and in the event of emergencies. The designated person(s) shall provide a cellular phone number as the main contact number, and one (1) alternate number. The designated person(s) shall respond to JEA with proposed

resolution within two (2) hours of receiving a call from a JEA representative or customer. If the Company fails to respond within the designated time and it is thereby necessary for JEA to provide assistance, the Company shall be responsible for all costs incurred by JEA as a result of resolving the concern.

Upon JEA approval, the Company shall deliver fliers and/or door hangers provided by Project Outreach to all customers in an affected work area at least three days prior to each construction activity including, but not limited to, locates, TV/cleaning, soil borings, mobilization, etc. Upon JEA's request, the contractor will install JEA provided signage at a location chosen by the JEA project team. These signs will be removed by the contractor at the end of the project.

The Company shall notify affected customers prior to any planned water/electric outages, line flushing, valve simulations and driveway/curb construction, paving and road closures. The notification will be produced by the Company (unless notifications are provided by JEA) and approved by JEA Project Outreach.

Customer Concerns:

The CSR shall contact the JEA customer who has a concern by the end of the business day of when the concern was received from JEA Project Outreach. The Company shall contact Project Outreach within two (2) business days to confirm that they have contacted the customer and assessed the concern.

The CSR shall provide JEA Project Outreach with concern evaluations, resolutions, and actions taken all within five (5) business days of when the concern was received.

The CSR shall notify Project Outreach immediately after a concern has been resolved with specific resolution actions or an update of the resolution. Project Outreach will contact the customer following notification of resolution to confirm the resolution before Project Outreach closes the concern and prior to notifying the Company, the CSR, JEA Representatives and inspectors of resolution of the concern.

Within one (1) business day of receiving a concern from a JEA customer, the Company shall notify JEA Project Outreach in writing of each customer concern reported directly to the Company's personnel by any JEA customer. Such notification shall include, as a minimum: the Company's name, date and time the concern was communicated to the Company, the name, address and phone numbers for the customer, the nature of their concern and any action that was taken or any action currently underway to resolve the concern. The CSR shall follow the customer concern procedures stated above.

If the Company fails to meet the problem resolution deadlines stated in this document in a manner that meets acceptable quality standards, JEA may make repairs or take other necessary actions to resolve the issue, which shall be at the Company's sole expense.

Duties of the Customer Service Representative (CSR)

The Company shall provide a Customer Service Representative for the Term of the Contract. The CSR's primary responsibilities shall include, but are not limited to the following:

Communication: Serve as the primary point of contact for customer concerns and information requests; report customer concerns to the JEA Project Manager and Project Outreach or other internal JEA resources and assist in resolution of issues; and meet with customers on site as needed to assess their concerns.

Planning: Conduct biweekly progress meetings with JEA Project Manager; conduct progress meetings with Project Outreach regularly and as needed to review any outstanding complaints and provide a timeframe/action plan for resolving them; review customer satisfaction targets and goals, measurements, documentation and project definition and assist with making improvements; conduct periodic customer service reviews during the course of the Work to

assess and identify any items considered to be at risk or vulnerable in relationship to meeting JEA goals and objectives; and notify Project Outreach, in a timely manner, of change in scope or schedule.

Process Improvement: Work with JEA to identify process improvement opportunities that increase customer service and satisfaction; make recommendations to JEA to enhance and assist with JEA goals and objectives for customer service; and conduct a customer service review at the completion of the construction phase of a project, but prior to the restoration, or "punch list" phase, to assess customers' satisfaction with the handling of concerns and customers' overall response to the project.

Disruption of Utility Services: If the Company disrupts any utility services (water, sewer or electric, etc.) during performance of the Work, the Company shall return them to operation as soon as possible. No disruption to any utility service disruption shall exceed the end of the Company's normal work shift. No disruption to the customer's utility services shall exceed any twelve (12) hour period. Should any of the customer's utility services be disrupted, for a period longer than twelve (12) hours, the Company shall provide alternative arrangements for the customer, as determined by JEA, with no additional cost to JEA for these arrangements unless otherwise specified in the documents. The CSR shall immediately notify JEA Project Outreach (telephone 665-7500) of any service disruptions.

Restoration: The Company shall restore, for no additional compensation, the landscaping of any properties affected by the Company's actions, directly or indirectly, (in the right-of-way not related to ongoing Work, or isolated Work in the right-of-way that would leave unrestored areas for undue periods of time subject to criticism) to its original state, within five (5) calendar days from the time the area was disrupted. All other restoration required within the right-of-way shall be scheduled in the customary method for such construction and in accordance with any permit conditions.

The Company shall, at its own expense (unless otherwise specified in the documents), repair any irrigation systems damaged by the Company's Work within one (1) day from the time the irrigation system was damaged. If this is not possible, the Company shall inform the customer of the damage and provide an estimated time for repair. In addition, the Company shall make adequate provisions for the customer to water and maintain his or her lawn.

The Company shall repair, at its own expense, any asphalt and concrete damaged by Company (in the right-of-way not related to ongoing Work, or isolated Work within the right-of-way that would leave unrestored areas for undue periods of time subject to residents/customer criticism) within five (5) calendar days from the time the damage occurred. All other restoration required within the right-of-way shall be scheduled in the customary method for such construction and in accordance with any permit conditions.

Customer Concern Ratios: Project Outreach's goal for customer concerns is to completely resolve all complaints within ten (10) business days of receiving a complaint. A formal customer concern shall be defined as a documented concern to JEA Project Outreach. The concern may be of a real or perceived problem that the customer has against the Company.

The JEA Project Manager or designee will notify the Company on a monthly basis of how many concerns were received by JEA's Project Outreach and the number of concerns yet to be resolved. JEA will immediately notify the Company when a concern has been opened and has not been a response to it within five (5) business days. The Company shall contact Project Outreach and provide a written correction plan within five (5) calendar days of receipt of the notice. If at any time the Company allows unresolved concerns to exceed the five (5) business days without prior notification to Project Outreach and the customer concern ratio reaches 3.0 percent, the Company shall be required to appear in front of the Company Performance Review Board to explain the circumstances leading to the unresolved concern. The Company Performance Review Board will notify the Chief Procurement Officer of the board's decision and any recommended actions, which may include, but are not limited to, additional remedial

action, termination of the Contract and/or suspension from JEA's Responsible Bidder's List in all categories for a period not to exceed one (1) year.

If the Company fails to adhere to the customer service requirements stated herein, the Company's performance shall result in a required hearing before the Company Performance Review Board. The Company Performance Review Board will consist of three JEA directors. The hearing will evaluate the Company's remedial action plan and determine whether such plan will be effective. The Company Performance Review Board will present its recommendation to the Chief Procurement Officer and recommended actions that may include additional remedial actions, termination of the Contract and/or suspension from JEA's Responsible Bidder's List in all categories for a period not to exceed one (1) year.

2.13.32. VIDEO/DIGITAL RECORDS

Prior to any alterations to the Work Location, the Company shall video record the entire Work Location. The Company shall provide original video recording to the Contract Administrator no later than fifteen (15) days after the date of the Notice to Proceed.

When required by the technical specifications, the Company shall provide a monthly video record (on DVD) of construction progress to the JEA Project Manager. If construction is being conducted in different localities, then video shall be taken at each Work Location. The JEA Project Manager reserves the right to select the views to be video recorded. DVD(s) shall be labeled with record of date taken, JEA's assigned project tracking number, and a brief description of times and activity covered in the video.

The Company shall take the progress video(s) between the 20th and 25th day of each month and submit the video(s) to the JEA Project Manager before the end of the 27th day of each month. If Company fails to submit the video(s) to the JEA Project Manager before the 28th day of each month, JEA reserves the right to have the video tape(s) taken by an independent Recording Company at the Company's expense.

In addition, the Company shall provide unedited video(s) with superimposed timer and vocal commentary of the preconstruction and post construction conditions. Video(s) shall be DVD format and include both sides of the right-of-way and record close attention to paved and unpaved driveways and walkways; conditions of lawns, shrubs, flowers, flower beds, and trees; conditions of pavement, fences, signs, planters and any other item within the area of the Work or adjacent right-of-way. The video(s) shall become a part of the Contract Administrator's and JEA Project Manager's permanent job records. The video(s) shall be indexed using the timer for locations by stationing and by street intersections.

The video(s) shall include each waterway crossing. An upstream and downstream view of each bank at the point of crossing shall be taken recording the inertial zone and/or mean high water level. Also, a view of the line route shall be taken from each bank of the crossing and elsewhere as the JEA Project Manager may direct. Construction shall not begin until video recordings are approved by the JEA Project Manager. The video(s) shall depict wet conditions of the Work Location and surrounding areas whenever possible.

2.13.33. WEATHER PROTECTION

The Company shall provide proper facilities, take all necessary precautions and assume the entire cost for protecting the Work against weather conditions and for handling all storm, flood and ground water, sewage, or other seepage, that may be encountered during the performance of the Contract. The Company shall provide for such contingencies and for carrying on the Work in freezing weather by methods that meet with the approval of the JEA Engineer. If the Company fails to provide such protection, or in the event of an emergency, JEA may provide such protection at the Company's expense.

2.13.34. WORK INFORMATION

In the event the Company requires additional information regarding the scope, technical specifications, Work Locations, personnel requirements, or other information pertinent to the Work or Contract, the Company shall request such information or clarifications from the Contract Administrator in writing. Within the bounds of the JEA Representative's authority, JEA Representatives may provide requested information to the Company.

2.13.35. WORK LOCATION CLEANLINESS

The Company shall, at all times, keep the Work Location free from an accumulation of waste materials or rubbish caused by its operations. At the completion of the Work, the Company shall remove all waste materials and any rubbish from and about the project, as well as any tools, construction equipment, machinery and surplus materials. If the Company fails to clean up at the completion of the Work, JEA may do so and charge the cost thereof to the Company.

2.13.36. WORKMANSHIP

The Company shall perform all Work in a safe and professional manner, so as to render a neat and uniform appearance. The Company shall handle all material in such a way as to preserve its finish and protective coatings from damage. General arrangement shall be in accordance with JEA Distribution Construction Standards and shall be satisfactory to the Contract Administrator.

2.13.37. COMPETENT PERFORMANCE OF THE WORK

The Company represents that it will conduct the Work in a manner and with sufficient labor, materials and equipment necessary to affect a diligent pursuance of the Work through Final Completion. If, in the sole opinion of JEA, the Company fails to perform the Work as represented, JEA may, at its sole discretion, take charge of the Work and furnish and provide the labor, materials, and equipment necessary to complete the Work as planned within the required time if JEA deems the organization of the Company or its management, or the manner in which Company is performing the Work, to be manifestly incompetent or inadequate to complete the Work as specified. The Company shall pay JEA for the cost of all such Work completed by JEA.

2.13.38. COMPLIANCE WITH REFERENCED SPECIFICATIONS

All Work, materials, systems or operations specified by reference to standard trade specifications or to manufacturer's published specifications shall comply with the requirements of the referenced specifications, except as modified by the requirements of the Contract Documents. The referenced specification used shall be the latest published edition that is in effect on the effective date of this Contract unless a particular edition is specified. In case of a conflict, the specifications that contain the more stringent requirements will govern.

2.13.39. COMPANY'S KNOWLEDGE OF THE WORK

The Company represents that its total Bid Price and the detailed schedule for the execution of the Work are based on its own knowledge and judgment of the conditions and hazards involved, and not upon any representation of JEA. JEA assumes no responsibility for any understanding or representation made by any of its representatives during or prior to execution of the Contract unless such understandings or representations are expressly stated in the Contract and the Contract expressly provides that JEA assumes the responsibility.

2.13.40. CONTRACTOR'S PLANS AND SPECIFICATIONS

All plans and specifications that the Contractor provides for any building, structure, system or equipment where required by federal, state, local laws and regulation as part of the Work shall bear the seal of a professional engineer duly registered in the State of Florida at no cost to JEA.

2.14. STANDARD REQUIREMENTS FOR CONSTRUCTION

2.14.1. PROTECTION OF THE ENVIRONMENT

The Company and its Subcontractors shall comply with all applicable laws, rules and regulations including, but not limited to, all Environmental Regulations.

A. Asbestos, Lead, or Toxic Mold Notification:

Asbestos, Lead, or Toxic Mold may be present at the Work Location. The Company shall notify the Contract Administrator immediately upon discovery of asbestos, lead, toxic mold. The Company shall not disturb or remove known or discovered asbestos, lead, or toxic mold unless directed by the JEA Representative.

B. Hazardous Materials:

The Company shall bear full responsibility including, but not limited to, payment and liability for the transportation, use, recycling, and disposal of any Hazardous Materials under the Company's control during the performance of the Work. Disposal or recycling of Hazardous Materials shall only be performed at JEA approved facilities. The Company shall provide JEA with appropriate documentation showing proper disposal or recycling of its Hazardous Materials.

The Company shall notify the Contract Administrator in writing of the type, quantity and disposal or recycling method of any hazardous material used during the performance of the Work. The Company shall be solely responsible for the use and disposal or recycling of any such materials. The Company shall submit cleanup procedures to the JEA Representative for review and written approval prior to the use of the hazardous material. In the event that a hazardous material escapes into the environment, the Company shall immediately notify the Contract Administrator in writing of the occurrence and the actions taken. In the event that the Company encounters hazardous materials in the course of construction, the Company shall immediately notify the Contract Administrator verbally, with a written notification to follow. The Contract Administrator shall arrange for disposal by JEA.

JEA has identified and labeled equipment known to contain PCBs. JEA will remove and transport any equipment so identified. The Company shall not remove or transport any equipment containing PCBs. The Company shall immediately notify the JEA Representative of any questionable or unmarked equipment, and the JEA Representative will arrange for testing and identification.

C. Waste Management:

The Company will be solely responsible for the proper management of all waste material, including but not limited to, paints, lubricants, fuels, solvents, drilling mud and materials, construction and demolition debris, used oil and oily waste, land clearing debris, universal waste (mercury containing lamps and devices, batteries, etc.) and other chemicals and hazardous materials used in connection with or generated during the Work, except as specified above. The Company will provide proper containers for waste materials and comply with all applicable laws, rules and regulations in their disposal or recycling. The Company will dispose of or recycle all empty containers off-site as soon as possible.

D. Wetlands:

The Company understands and agrees that the Work Location may include wetlands or other environmentally sensitive areas. The Company shall not enter these areas during the performance of its Work, unless specifically authorized by the Contract Administrator and appropriate state and federal permits have been obtained.

E. Wildlife:

The Company and/or Subcontractor's employees shall not endanger wildlife species or domestic animals of any kind.

F. Violation of Environmental Laws and Permits:

The Company shall immediately cease any activity that causes or results in a violation of JEA's or Company's environmental permits or federal, state and local laws and regulations. Such violation shall immediately be reported to the Contract Administrator verbally, with written notification to follow. All additional costs due to the Company's noncompliance with the applicable environmental permits or Environmental Regulations shall be paid by the Company.

2.14.2. NPDES PERMIT CONFORMANCE

The Company shall obtain all other applicable local, state, and federal permits. It is unlawful to have any discharges that are not composed entirely of stormwater (except discharges pursuant to a NPDES permit) to the municipal separate stormwater system (MS4). Only non-contaminated water/non-turbid water shall be transported through the MS4. Groundwater discharge (approved by JEA) from dewatering activities may be routed into the stormwater system providing that erosion, and transportation of suspended solids to the system is prevented. If contaminated soil or contaminated groundwater is encountered, the dewatering activity shall cease immediately, and the Company shall contact the Florida Department of Environmental Protection and notify the appropriate department of the incident immediately.

2.14.3. NPDES PERMIT CONFORMANCE - DEWATERING

If Company encounters groundwater, the Company shall be responsible for obtaining; a *Generic Permit for Discharge of Produced Ground Water From any Non-Contaminated Site Activity* from the Florida Department of Environmental Protection (FDEP), and a *Noticed General Permit for Short-term Construction Dewatering* from the St. Johns River Water Management District (SJRWMD) before any dewatering activities can begin.

Company shall also be responsible for developing and utilizing a dewatering system(s) to remove water from the excavations. Prior to beginning any dewatering, the Company shall submit a dewatering plan to JEA for review. The Company shall comply with all sampling requirements listed in FDEP regulation (62-621.300(2) F.A.C.) before any dewatering can begin. The Company shall submit to JEA the sampling analysis results. In the event the sample analysis fails to meet FDEP water quality standards as established in applicable rule, the Company shall not proceed with further permitting or dewatering activities, shall notify JEA of any failure to meet applicable standards, requirements, or rules, and shall await instruction from JEA.

The dewatering plan developed by the Company shall further consider the dewatering volume as estimated using traditional and customary methods. The dewatering plan shall comply with the requirements of 40C-2 and 40C-22, F.A.C., and additional requirements as may be mandated or amended by SJRWMD. In the event the dewatering plan does not comply with those requirements applicable to the *Noticed General Permit for Short-term Construction Dewatering* the Company shall not proceed with further permitting or dewatering activities, shall notify JEA of any failure to meet applicable standards, requirements, or rules, and shall await instruction from JEA.

If the above requirements are not followed, the Company shall be held liable for any fines and/or violations incurred by JEA.

2.14.4. NPDES PERMIT CONFORMANCE - STORMWATER POLLUTION PREVENTION

The Company shall obtain as necessary a *Generic Permit for Stormwater Discharge from Large and Small Construction Activities (CGP)*, and shall develop a Stormwater Pollution Prevention Plan (SWPPP) compliant with local, state, and federal rules, laws, and ordinances. Company shall be responsible for implementing the SWPPP,

installing and maintaining in a functional manner structural and nonstructural best management practices as described therein, evaluating the effectiveness of the best management practices, and employing additional performance based best management practices as may be deemed necessary by JEA. The Company, at its own expense, shall revise, or include as addendum to the SWPPP measures as maybe required by a local, state, or federal authority to remain compliant with local, state, and federal rules, laws, and ordinances.

No additional payments shall be made to Company for revisions or addendums to the SWPPP, or for the actual implementation of those revisions on the Work site, including those made so as to achieve functional performance based best management practices.

The Company shall obtain all other applicable local, state, and federal permits subsequent to notification of JEA of the need for such authorization(s). It is unlawful to have any discharges that are not composed entirely of stormwater (except discharges pursuant to a NPDES permit) to the Municipal Separate Stormwater System (MS4). Only non-contaminated water/non-turbid water shall be transported through the MS4. Groundwater discharge (approved by the FDEP pursuant to 62-621.300(2)) from dewatering activities may be routed into the stormwater system, drainage ditch, creek, river or wetland providing that erosion, and transportation of suspended solids to the system is prevented. If contaminated soil or contaminated groundwater is encountered, the dewatering activity shall cease immediately, and the Company shall contact JEA's Environmental Coordinator, Andrew Sears at (904) 665-7719.

All contractors conducting land disturbing activities shall have at least one (1) corporate representative that is certified for the Florida Department of Environmental Protection Erosion and Sediment Control Inspector Training Manual.

For projects with greater than one (1) acre of disturbed land, a person certified pursuant to the Florida Department of Environmental Protection's Erosion and Sediment Control Inspector Training Manual or trained by a certified person shall make the routine inspections shall be maintained and kept on the construction site and made available for inspection during land-disturbing activities. Such inspection shall be made no less than daily and a log of such inspections shall be maintained and kept on the construction site and made available for inspection by City and JEA inspectors throughout the duration of land-disturbing activities. If the inspector is trained by a certified person but not certified themselves, accurate training records must be kept and evidence of annual refresher training shall be maintained.

Any required erosion and sediment control plans submitted to the City of Jacksonville must conform to the requirements in the FDEP's Florida Department of Environmental Protection's Erosion and Sediment Control Inspector Training Manual or the provisions contained in the Land Development Procedures Manual, whichever

Upon approval to proceed to do so by the Owner, the Company shall complete a *Notice of Termination (NOT)* (DEP Doc. No. 62-621.300(6), F.A.C.), to terminate the CGP coverage within one (1) week of final site stabilization.

If the above requirements are not followed, the Company shall be held liable for any fines and/or violations incurred by JEA.

2.14.5. PREVENTION, CONTROL AND ABATEMENT OF EROSION AND SILTATION

The Company shall take steps and make suitable provisions to minimize siltation and erosion of waterways that may result from its operation during the course of construction.

The Company shall make suitable arrangements, which may require the temporary construction of flumes, boxes, or some other device(s), at the Work Location for the drainage and disposal of water. The Company shall be responsible for protecting adjacent property to the Work Location from damage by water resulting from its operations. The Work Location shall be returned to its original condition to the satisfaction of JEA.

The Company is cautioned that execution or maintenance that creates turbidity and that directly or indirectly affects the water quality of any waterway into which storm water is discharged in such a manner as to exceed the limitations prescribed in the Florida Administrative Code, is a violation of the water quality standards of the State of Florida.

Turbidity shall not exceed 29 NTU's, above background level within 100' of the construction activity. Costs incurred by the Company for compliance to the restrictions outlined above shall be included in the cost of the items for which the turbidity control is required, unless a separate line item is included in the Bid Document for turbidity control. Silt barriers shall be used at all waterway crossings or at any time during construction that siltation or erosion may occur. The Company shall submit to the JEA Engineer, for written approval prior to construction, the method to be used to control the turbidity. The JEA Engineer's approval of the method to be used in no way relieves the Company of the liability in case of a citation against JEA.

2.14.6. SILT FENCE ASSEMBLY

The Company shall furnish and install silt fence assembly (including fabric, stakes, etc.) in accordance with the details shown on the Erosion Control Drawings and as required by the Storm Water Pollution Prevention Plan (SWPPP). Company will be responsible for all costs associated with silt fence assembly. There will not be a separate line item for silt fence assembly on the Bid Form.

2.14.7. DRAINAGE ALONG RIGHTS-OF-WAY

The Company shall so conduct its operations and maintain the Work in such condition that adequate drainage shall be in effect at all times. The Company shall not obstruct existing gutters, ditches and other runoff facilities.

2.14.8. FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION (FDEP) CERTIFICATION OF COMPLETION

Following satisfactory bacteriological clearance, installation and testing of the piping systems or mains installed under the Contract, the Company shall submit to the Contract Administrator Company-certified, as-built drawings of sufficient detail and accuracy to allow application to FDEP in accordance with the provisions set herein for Certification of Completion. This Certification of Completion must be obtained prior to making final tie-ins and/or service transfers or connections. The Company shall schedule its Work to allow sufficient time for processing the Certificate of Completion. The submittal of as-built drawings in order to obtain the FDEP Certificate of Completion does not relieve the Company of the requirement to submit final as-built drawings as specified in the Contract Documents.

2.14.9. HAND DIGGING AROUND TREES, TREE TRIMMING, ARBORIST SERVICES AND TREE REMOVAL

No separate measurement and payment shall be made for hand digging around trees, tree trimming, and provision of arborist services, but all cost shall be included in the associated item of work in the bid form. Hand digging, tree trimming, and arborist services shall include but not be limited to all labor, equipment and supervision required to successfully hand dig or trim tree branches where tree roots or branches may be destroyed or injured due to the Work. Item shall include services of a certified arborist as required by the City landscape architect to ensure minimal or no damage to tree canopy or root system. If the tree canopy or root system is damaged, the Company, at its own expense, shall repair, restore, or replace the tree at the direction of the arborist. The Company shall review the

drawings and visit the Work area prior to the bid to satisfy itself as to the amount of tree removal and disposal to be performed to complete the Work, and the extent of tree trimming required to perform the work. All tree mitigation costs shall be borne by the City of Jacksonville. Trees identified on the drawings for removal shall not be paid for separately, but all associated cost for removal and disposal and subsequent compacted soil backfill replacement shall be included in the associated item of the work.

2.14.10. APPLICABLE WATER AND SEWER STANDARDS, DETAILS AND MATERIALS

All Work shall be done in accordance with the latest version JEA Water and Sewer Standards, Details and Materials. The JEA Water and Sewer Standards, Details and Materials manual may be obtained from jea.com.

2.14.11. INTERRUPTION OF SERVICE

The Company shall not operate any valves, nor otherwise interrupt water and/or sewer service, without first obtaining permission from the JEA Engineer. The JEA Representative shall be present during any interruption of service.

If the Company must shut down a main or portion of a main, thereby causing an interruption of water service, the Company shall provide the JEA Engineer with the following information, in writing, a minimum of four days in advance of any anticipated interruption of service:

- o Date and time of outage.
- o Purpose of the outage.
- o Map of the area to be affected by the outage.
- o Letter stating all offices, businesses, and residents have been or will be notified by Company at least four days in advance of the outage (unless JEA chooses to issue such notification).

The Company is not authorized to proceed with requested Work without prior written notice from JEA Engineer that such actions are approved.

In the event of a major emergency that endangers life or property, the Company may take immediate action before notifying JEA. In all cases, however, JEA shall be notified in writing at the earliest opportunity after addressing the emergency.

2.14.12. MAILBOXES

The Company shall carefully remove and relocate mailboxes affected by construction operations to allow for uninterrupted mail service. All temporarily relocated mailboxes shall be reinstalled permanently as soon as construction operations allow. The condition of the reinstalled mailboxes shall be at least equal to the original facility, as directed by JEA. Company shall be responsible for removal, relocation or reinstallation of mailboxes. There will not be a separate line item for Mailbox removal, relocation or reinstallation on the Bid Form.

2.14.13. METERS

The Company shall pay all fees and charges required for connections to utilities, concurrency management, parking meter rental/removal and any other assessments imposed on the Work or initial occupancy of the Contract, except those specifically listed herein as provided by JEA.

2.14.14. SEWAGE SPILLS

The Company shall minimize the amount of sewage released into excavations by notifying affected parties of the service interruption, pre-draining affected lines, insuring pump station (non-)operating status, etc. The Company shall notify JEA immediately verbally, with written notification to follow.

The Company shall take precautions to prevent sewage from contacting the ground. If sewage contacts the ground, the Company shall take appropriate measures to disinfect the area of the sewage release. If pooling sewage is observed, the Company shall vacuum remove the sewage, or remove the sewage by other means acceptable to the JEA Representative, and dispose of the sewage in accordance with environmental and public health regulations. The Company shall clear any sanitary systems found plugged due to this type of pumping activity at its own expense.

2.14.15. SUBSURFACE INVESTIGATION

A geotechnical exploration of existing conditions including soft digs where necessary in the general area of the proposed Work has been performed and a report of the findings and recommendations are attached

2.14.16. SURVEYING

Unless specifically stated in the Contract Documents as being provided by JEA, the Company shall be responsible for all surveying necessary to commence and perform this Work. The Company shall employ a land surveyor registered in the State of Florida to reference and restore all property corners and/or monuments that may have been disturbed and to ensure accurate horizontal and vertical control during the construction of this project and for staking locations for new structures. Height and spacing of stakes to be as specified elsewhere herein or as directed by JEA Engineer.

All Work shall be done to the lines, grades and elevations shown on the drawings. Any Work improperly located may be ordered removed and replaced at the Company's expense. The Company shall be responsible for making its own determination of water table variations and shall not assume that any water levels shown by the aforesaid boring data will necessarily be maintained at the level indicated. The Company shall investigate the conditions above or below the surface of the ground as it may deem necessary for the proper and timely performance of its Work including, but not limited to, the making of borings.

2.14.17. TEMPORARY ROADWAYS

If the Company's operations render any street or private way unsafe, the Company shall make such repairs or provide such temporary ways and guards necessary for the protection and safety of JEA's and the Company's employees and subcontractors, and the public, and for the orderly maintenance of traffic.

The Company shall always provide and maintain a hard-surfaced roadway for traffic. Where temporary detours of lanes are required, they shall be asphalt-paved by the Company. The Company may construct paving section(s) appropriate to support traffic, provided the surface is smooth and the profile reasonable, and as a minimum, consists of 1 inch of bituminous structural course over a six inch (6") limerock base that was inspected and approved by the JEA Engineer. Should any temporary pavement fail, the Company shall be responsible for repairing it, at its own cost, before close of Work on the day notification is given. Should the Company be unable to make such repair by close of Work, the Company shall notify the Contract Administrator and provide an estimated time when repairs can be made. No repair timeframes shall exceed forty-eight (48) hours. Any damages, either direct or indirect, resulting from such temporary pavement failures shall be the sole liability of the Company.

All limerock base material used for temporary pavement and constructed in proposed grassed areas shall be completely removed and disposed of by the Company prior to final restorative grassing operations. The area shall be

backfilled with material stockpiled on the Work Location that is conducive to growth of the plant material. All costs associated with this work shall be included in the cost for the associated item of work.

2.14.18. BYPASS PUMPING

The Company shall provide all necessary labor, materials and equipment to maintain the uninterrupted sewer service of laterals, mains, trunks, force mains and pump stations at all times. The manner in which this is accomplished shall be left to the discretion of the Company, subject to the requirements of the Contract and the prior approval of the JEA Engineer. The JEA Engineer's approval in no way relieves the Company of any liabilities resulting from the bypass method chosen.

The Company shall not allow any sewage, at any time, to be pumped into any drainage structure or to spill, puddle, or run upon any street, construction trench, public or private property.

The responsibility for coordinating the need, length of time, method, and suction and discharge locations for bypass pumping shall be the responsibility of the Company subject to approval by the JEA Engineer.

2.14.19. TRAFFIC SIGNAGE

Costs incurred by the Company to provide new signage and pavement markers, or remove and replace existing signage as necessary to accomplish the work shall not be paid for separately but shall be merged with the cost of the associated item of work. Damaged signage shall be replaced with new signage. All signage and pavement markers in accordance with the drawings and City Traffic Engineer's requirements.

2.14.20. TREE PROTECTION

The Company shall protect all trees, in accordance with applicable city and county laws, from damage by vehicles, equipment and machinery, except those trees designated for removal on the construction drawings and for which the Company shall be responsible for obtaining all required approvals and permits. Removal of any tree not so designated nor permitted, shall be only upon specific approval by the JEA Engineer.

Excavated dirt shall not be piled around the base of any tree not designated for removal. The Company shall not bury or burn any refuse around or near the trees. The Company shall proceed with caution when excavating in the vicinity of root structure of any tree. Excavation shall be by hand if necessary.

Roots up to 2" in diameter when severed do not require any pruning paint. Roots from 2" to 4" in diameter must be severed with a pruning saw and painted. Roots over 4" shall not be severed except as directed by the JEA Engineer.

An ax or similar tool is not acceptable for pruning. The wood shall be treated with asphalt-type pruning paint as soon as possible after pruning.

Prior to any site disturbance, barriers shall be put up around each tree to be protected. These barriers shall be constructed of 2 x 4's or any other practical materials that will discourage disturbance near the tree. To conform to applicable city and county laws and codes, these barriers should be at least six feet (6') away from the trunk of the tree and protect an area that is at least fifty percent (50%) of the unpaved area covered by the crown spread of the tree. When conditions permit, barriers are to be placed in such a manner as to provide the largest undisturbed area possible.

Cutting tree roots shall be kept to a minimum and only allowed when absolutely necessary. In such instances the Company shall ensure that all cuts are made clean with a saw, free of all loose soil, and sealed with pruning paint or shellac. At no time shall roots be pulled, ripped or cut with a blade, backhoe or other mechanical device. Additional

fill under the crown spread of trees shall be kept to a minimum. If additional fill is unavoidable, all fill material shall consist of clean, coarse sand or gravel, free of silt and clay to allow for free movement of air and water. Lowering the grade under the crown spread of trees will not be permitted.

Should branches require pruning to provide for roadway or other necessary clearance, they shall be cut back to a main stem or crotch of the tree. All cuts shall be made at the bench collar to allow the natural healing process of the tree to occur. To further promote the natural healing process, no pruning paint or other material shall be applied to pruning cuts.

If a tree is wounded during construction, all bark surrounding the wound shall be cut away and carefully removed. Care shall be taken to leave as much cambium as possible.

Any tree whose root system has been disturbed or damaged must be properly fertilized to aid in its recovery. The hole or punch-bar method shall be used for applying fertilizer. The holes should be approximately 12" to 18" deep, 1" to 2" in diameter, 2' apart, and extend 2' past the drip line of the tree. The Company shall not apply fertilizer within 1 foot of the trunk of a small tree (up to 6" in diameter) or within 3' of the trunk of a large tree (over 6" in diameter). Injury to the root collar and trunk base may result. The type of fertilizer to be used shall be 25% organic 8-8-8 with minor elements included. Chemical analysis as follows: Total Nitrogen, not less than 8.00%, available Phosphoric Acid, not less than 8.00%, water soluble potash, not less than 8.00%. Fertilizer shall be applied at the following rates and shall be evenly distributed among the holes:

Hardwoods up to 6" Dia. 2 lb. per inch of Dia.

Hardwoods over 6" Dia. 4 lb. per inch of Dia.

Evergreens up to 6" Dia. 1 lb. per inch of Dia.

Evergreens over 6" Dia. 2 lb. per inch of Dia.

2.14.21. CONSTRUCTION PARKING

No Company employee vehicular parking will be allowed within the construction footprint. All parking will be offsite. Company shall be responsible for ferrying its employees to and from the Work Location. This will reduce the number of complaints associated with number of vehicles clogging roadways and ruts associated with offstreet parking, as well as provide additional ingress/egress corridor for required construction vehicles.

2.15. VENDOR PERFORMANCE EVALUATION

2.15.1. VENDOR PERFORMANCE EVALUATION

Use of Vendor Performance Evaluation Scorecards

JEA may evaluate the Company's performance using the evaluation criteria shown on the vendor scorecard available online at JEA.com.

Scores for all metrics shown on the evaluation range from a low of 1, meaning significantly deficient performance, to a high of 5, meaning exceptionally good performance. The Company's performance shall be classified as Top Performance, Acceptable Performance, or Unacceptable Performance, as defined herein. The evaluator will be a designated JEA employee. The evaluator's supervisor and the Chief Purchasing Officer will review deficient performance letters and Unacceptable Performance scorecards, as described below, prior to issuance. When evaluating the Company's performance, JEA will consider the performance of the Company's Subcontractors and suppliers, as part of the Company's performance.

Frequency of Evaluations

JEA may conduct performance evaluations and prepare scorecards in accordance with the procedures described herein at any time during performance of the Work or soon after the completion of the Work. JEA may conduct one (1) or more evaluations determined solely at the discretion of JEA.

Unacceptable Performance

- If at any time, JEA determines, using the criteria described on the scorecard, that the performance of the Company is Unacceptable, the Contract Administrator and Chief Procurement Officer or his designated alternate will notify the Company of such in a letter. The Company shall have ten (10) days to respond to the Contract Administrator. Such response shall include, and preferably be delivered in-person by an officer of the Company, the specific actions that the Company will take to bring the Company's performance up to at least Acceptable Performance.
- Within thirty (30) days from date of the first Unacceptable Performance letter, the Contract Administrator and Chief Purchasing Officer or his designated alternate will notify the Company by letter as to whether its performance, as determined solely by JEA, is meeting expectations, or is continuing to be Unacceptable. If the Company's performance is described in the letter as meeting expectations, no further remedial action is required by the Company, as long as Company's performance continues to be Acceptable.
- If the Company's performance as described in the letter continues to be Unacceptable, or is inconsistently Acceptable, then the Company shall have fifteen (15) days from date of second letter to demonstrate solely through its performance of the Work, that it has achieved Acceptable Performance. At the end of the fifteen (15) day period, JEA will prepare a scorecard documenting the Company's performance from the start of Work, or date of most recent scorecard, whichever is latest, and giving due consideration to improvements the Company has made in its performance, or has failed to make. If the scorecard shows Company's performance is Acceptable, then no further remedial action is required by Company as long as Company's performance remains Acceptable. If the scorecard shows the Company's performance is Unacceptable, JEA will take such actions as it deems appropriate including, but not limited to, terminating the Contract for breach, suspending the Company from bidding on any JEA related solicitations, and other remedies available in the JEA Purchasing Code and in law. Such action does not relieve the Company of its obligations under the Contract, nor does it preclude an earlier termination.
- In the event that the Contract Term or the remaining Term of the Contract does not allow for the completion of the deficient performance notification cycles described above for those in danger of receiving an Unacceptable Performance scorecard, JEA may choose to accelerate these cycles at its sole discretion.
- If the Company receives five (5) or more letters of deficiency within any twelve (12) month period, then JEA will prepare a scorecard describing the deficiencies and the Company's performance will be scored as Unacceptable.

Acceptable Performance

JEA expects the Company's performance to be at a minimum Acceptable.

Disputes

In the event that the Company wants to dispute the results of its scorecard performance evaluation, the Company must submit a letter to the Chief Procurement Officer supplying supplemental information that it believes JEA failed to take into account when preparing the scorecard. Such letter, along with supplemental information, must be submitted no later than ten (10) days following the Company's receipt of the scorecard. If the Chief Procurement Officer decides to change the scorecard, the Company will be notified and a revised scorecard will be prepared, with a copy issued to the Company. If the Chief Procurement Officer decides that no change is warranted, the decision of

the Chief Procurement Officer is final. If the Company is to be suspended from consideration for future Award of any contracts, the Company may appeal to the Procurement Appeals Board as per JEA Procurement Code.

Public Records

There can be no expectation of confidentiality of performance-related data in that all performance-related data is subject to disclosure pursuant to Florida Public Records Laws. All scorecards are the property of JEA.

2.16. JEA RESPONSIBILITIES

2.16.1. DENSITY TEST ALLOWANCE

JEA will provide funds as specified on the bid sheet to reimburse Company at cost for hiring one (1) or more testing laboratory(ies) to perform all sampling, field testing and laboratory testing as specified herein, or as directed by the JEA Engineer. All testing is to be performed under the direct supervision of a registered geotechnical engineer paid for with the allowance. The testing allowance is to be used for first tests only. Any retesting due to failed first tests shall be at Company's expense. Company shall clearly mark on its invoices costs associated with testing services identifying the cost to Company of the testing service. Company agrees to invoice JEA for testing services at its cost with no markup.

2.16.2. ACCESS TO THE WORK LOCATIONS

JEA will provide, as indicated in the Contract Documents, and no later than the date when needed by the Company, access to the Work Location, including rights-of-way or access thereto, and such other lands that are designated for the Company's use. JEA will secure easements for permanent structures or permanent changes in existing facilities, unless otherwise specified in the Contract Documents.

2.17. CHANGES IN THE WORK, CONTRACT TIME OR PRICE

2.17.1. AMENDMENTS

This Contract may not be altered or amended except in writing, signed by JEA Chief Procurement Officer, or designee, and the Company Representative, or each of their duly authorized representatives.

2.17.2. FORCE MAJEURE

No party shall be liable for any default or delay in the performance of its obligations under this Contract due to an act of God or other event to the extent that: (a) the non-performing party is without fault in causing such default or delay; (b) such default or delay could not have been prevented by reasonable precautions; and (c) such default or delay could not have been reasonably circumvented by the non-performing party through the use of alternate sources, work-around plans or other means. Such causes include, but are not limited to: act of civil or military authority (including but not limited to courts or administrative agencies); acts of God; war; terrorist attacks; riot; insurrection; inability of JEA to secure approval, validation or sale of bonds; inability of JEA or the Company to obtain any required permits, licenses or zoning; blockades; embargoes; sabotage; epidemics; fires; hurricanes, tornados, floods; or strikes.

In the event of any delay resulting from such causes, the time for performance of each of the parties hereunder (including the payment of monies if such event actually prevents payment) shall be extended for a period of time reasonably necessary to overcome the effect of such delay, except as provided for elsewhere in the Contract Documents.

In the event of any delay or nonperformance resulting from such causes, the party affected shall promptly notify the other in writing of the nature, cause, date of commencement and the anticipated impact of such delay or

nonperformance. Such written notice, including Change Orders, shall indicate the extent, if any, to which it is anticipated that any delivery or completion dates will be thereby affected within seven (7) calendar days.

2.17.3. EFFECTIVENESS OF CHANGE ORDER

Any change in the Contract resulting from the RFI will be incorporated into the Contract through the use of a Change Order, Supplemental Work Authorization or Purchase Order. Whether requested by the Company, claimed by the Company, or contemplated by JEA, no change shall be authorized and effective unless made through an approved Supplemental Work Authorization (SWA) or on a JEA Change Order signed by the Contract Administrator or through a formal written amendment to this Contract. All Work defined on Change Orders shall be subject to the conditions of the Contract, unless specifically noted on the Change Order.

2.17.4. INITIATION OF A CHANGE BY COMPANY

To request any change in the Work including, but not limited to, changes in scope, quantities, price, or schedule, the Company shall submit a written request in the form of a Request for Information ("RFI") to the JEA Representative within ten (10) working days of the date that the event that prompted the change was discovered or should have been discovered. The RFI shall contain sufficient information regarding the nature of the requested change, including an itemized estimate of cost, either positive or negative, in relation to the change, and any effect on contract time which is related to the changed condition, and work descriptions and other information necessary to evaluate the merits of the change. The JEA Representative may reject RFI's which do not provide sufficient supporting information. Upon receipt of the Company's RFI, the JEA Representative will provide written direction as to the procedures that will be used to address the request. JEA shall have the right to approve or disapprove any RFI, request or claim for change as it deems necessary and in its best interests consistent with the other Contract requirements. Where JEA and the Company are unable to reach a mutually acceptable resolution for the RFI, JEA will make a commercially reasonable determination, made in accordance with JEA's Procurement Code, which shall be final.

2.17.5. INITIATION OF A CHANGE BY JEA

When it is in JEA's best interest, the JEA Representative may request that the Company provide pricing information to accommodate a requested change in the Work, including a change to the scope of Work, quantity, schedule or completion date. Upon the written request by JEA, the Company shall submit a cost estimate, including all pricing elements requested by JEA. The Company shall not proceed with any changes to the Work until such change is authorized in writing.

2.17.6. NO DAMAGE FOR DELAY

Damage, loss, expense or delay incurred or experienced by the Company in the prosecution of the Work by reason of unforeseen circumstances, unanticipated difficulties and obstructions, bad weather, or other mischances that are generally considered to be a part of the usual hazards associated with Work, shall be borne entirely by the Company and shall not be the subject of any claim for additional compensation or change in Approved Schedule.

The Company agrees that its sole remedy for any claims, damages or losses related to any delay, disruption or hindrance alleged to be caused by JEA or any of JEA's agents or other contractors, shall be an extension of the Contract completion date.

Any demand for equitable time adjustment must be served in writing to JEA within five (5) days of the event giving rise to the delay, disruption or hindrance. Any request for an equitable time adjustment shall be accompanied by a logical time impact analysis, demonstrating the nature and magnitude of the event to the critical path.

Failure to strictly comply with these requirements shall be deemed a waiver of any right to seek equitable time adjustment.

In the event the "no damage for delay" clause is inapplicable, there shall be no recovery for home office overhead and any damages claimed shall be proven by discreet accounting of direct project costs and no theoretical formula or industry estimating reference manuals shall be permissible.

2.17.7. QUANTITIES

Where the total Bid Price was based on estimated quantities, prior to making final payment, JEA will determine actual quantities using sampling, surveying and other industry recognized means and prepare a Change Order adjusting the Contract Price to reflect actual volumes.

The Company shall immediately notify the JEA Contract Administrator in writing of any unauthorized change in the scope of the Work or significant change in the quantities of the Work that may increase the Contract Price, require an extension of Work schedule, or negatively impact permitting or other regulatory requirements.

2.17.8. USE OF THE SUPPLEMENTAL WORK AUTHORIZATION (SWA)

The JEA Representative will issue a written SWA to incorporate cost or schedule changes into the Contract. Issuance of an SWA is solely at the discretion of the JEA Representative. The SWA shall be used for increases or decreases in the Contract price, within the SWA amount set forth in the Bid, or to make changes in schedule for performance of the Work. An SWA shall authorize the Company to perform changes in the Work. The Company shall not start on SWA work until the Company receives a fully authorized, written SWA form, signed by the appropriate JEA personnel - the Company shall not consider verbal statements as authorization to proceed with the changes. The Company should not expect that any SWAs will be issued. JEA shall have no obligation to pay for SWA work unless the same is performed pursuant to a written SWA form signed before the SWA work is commenced.

2.17.9. WHEN SWA EFFECTIVE

The Company shall not start on SWA work until the Company receives a fully authorized, written SWA form, signed by the appropriate JEA personnel. The Company shall not consider verbal statements as authorization to proceed with the changes. An SWA shall authorize the Company to perform changes in the Work. JEA shall have no obligation to pay for SWA work unless the same is performed pursuant to a written SWA form signed before the SWA work is commenced.

In determining costs for Work associated with any Change Order or an SWA, the following methods may be used:

1. Agreed Upon Lump Sum Method

- a. The Company and the JEA Representative shall mutually agree to the pricing of a change order or an SWA. Any negotiated increase or decrease in the Contract Price shall be based on the Company's costs for labor, materials and supplies directly applicable to the increase or decrease plus ten percent (10%) thereof for Company's supervision, overhead, bonds and profit. For any negotiated increase or decrease, the Company will provide a complete detailed breakdown for all labor, material, and equipment, etc. associated with the change. The detailed breakdown shall include applicable labor rates for all trades used, equipment rates, labor and equipment hours. A lump sum figure submitted with no breakdown will be returned to the Company without review.
- b. Where the work is covered by established Unit Prices contained in the Contract, and JEA agrees that the Unit Price in the Contract is a fair and reasonable price, the Unit Price will be applied to the quantity of work. In the event that JEA does not agree that the Unit Price in the Contract is a fair and reasonable price, a negotiated price will be applied to the quantity of work at the discretion of the JEA.

2. Cost Reimbursable (Time and Materials) Method

- a. Whenever the Company and the JEA are unable to agree on costs for an increase in the Work, JEA or JEA Representative shall order the Company to proceed with the Work on a cost reimbursable (time and material) basis. JEA will pay the Company for the SWA work in the manner hereinafter described, and the compensation thus provided shall constitute full payment for said work. JEA shall issue the SWA for the Company to perform the specific work with payment determined as follows:
- b. For materials purchased by the Company and used in the work, the Company shall be paid the actual cost of such materials, including sales taxes if required, and freight and delivery charges as shown by original receipted bills. A mark-up amount equal to ten percent (10%) of the sum thereof shall be added to this cost. JEA reserves the right to select and approve, or to reject the materials to be used and the sources of supply of any materials furnished by the Company.
- c. The Company will be paid the cost of wages for all labor that is engaged in the Work, plus the actual cost chargeable to the Work for workers compensation insurance, social security taxes, unemployment compensation insurance and such additional amounts as are paid by the Company. A total mark-up shall be added equal to ten percent (10%) of wages and other cost listed above. In evidence of the costs of labor the Company shall provide a certified statement of wages actually paid, together with copies of supporting payrolls. Wage rates used in determining the amount of the payment will be the actual wage rates paid by the Company for Work under this Contract, except that no rate used shall exceed the rate of comparable labor currently employed on the project.
- d. Payment for the services of foremen in direct charge of the specific operation will be made. Payment for the service of superintendents, timekeepers or other overhead personnel will not be made nor will payment for the services of watchmen be made unless required specifically by the SWA Work. The actual function performed by an employee rather than its payroll title will be the criterion used in determining the eligibility of an employee's services for payment under this provision.
- e. The types and amounts of equipment and machinery used by the Company in carrying out its work under the SWA shall be made in keeping with normal practice for work of similar nature. JEA may, at its discretion, limit by specific instruction the types and amounts of equipment and machinery to be used. For all equipment and machinery used in the SWA work, JEA will pay the lowest of the following options to which no mark-up percentages will be added (note that these options apply to rented or contractor owned equipment):

80% of the rental value as set forth in the Blue Book value, or

- Actual cost, or
- Current local equipment rental company quote as produced by JEA.
- In computing the hourly rental of such equipment, the following applies:
 - The lowest calculated hourly equipment rental rate shall be used based on the duration that the equipment is at the site and/or the actual cost the Company is paying. For example, if the equipment used has been on the project for more than one (1) month, then the hourly rate used shall be derived/calculated from the monthly equipment rate.
 - Less than thirty (30) minutes shall be considered 1/2 hour except when the minimum rental time to be paid is one (1) hour.

Rental time will not be allowed while equipment is inoperative due to breakdowns. The rental time of equipment to be paid for shall be the time the equipment is in operation on the SWA work being performed. The Company shall be reimbursed for the time required to move the equipment to the Work, and return it to its original location, only if the Company is charged this cost by the renting agency. Excess rental time of equipment due to inefficient work practices will not be reimbursed. Actual costs must be supported by invoices or other similar documentation provided by the Company.

- f. No payment will be allowed for the use of small tools and minor items of equipment, which, as used herein, are defined as individual tools or pieces of equipment having a replacement value of \$500.00 or less.
- g. The Company and JEA Representative shall compare records of the Work performed on a Cost Reimbursable basis at the end of each day. These records shall be prepared by the Company and shall be signed by both JEA and the Company Representative. A copy of these records shall be submitted to JEA with the invoice for the work.
- h. Payment for cost reimbursable SWA work will be included in monthly progress payments.
- i. The Company's Subcontractors will be allowed a ten percent (10%) mark-up on Work performed by their own forces. The Company will be allowed a five percent (5%) mark-up on the Subcontractor's costs (i.e. labor and materials) only, no mark-up on the Subcontractor's profit.
- j. Subcontractor's costs in excess of fifty thousand dollars (\$50,000) shall be justified for competitiveness through the submission of at least three (3) Bids for the work, or other cost justification satisfactory to JEA.

2.17.10. CHANGES IN THE WORK

Changes in the Work, including changes to scope, quantities, price, schedule or completion date, may be authorized through Supplemental Work Authorizations or through a Change Order.

2.17.11. CHANGES TO WORK SCHEDULE OR TIME

The Work schedule and/or contract time may be changed by a Change Order, Purchase Order or SWA. The Company's request or claim for a Work schedule and/or contract time adjustment shall be in writing delivered to the Contract Administrator within ten (10) working days following the discovery of the event that prompted the claim or the date when the event should have been discovered. Where accepted by JEA, changes to Work schedule will only adjust for critical path impacts. Failure to include the necessary critical path analysis with the request shall be grounds for rejecting the claim. The critical path as used in this Section means the series of interdependent Work events that must be sequentially performed and that require a longer total time to perform than any other such series. Upon receipt of the Company's request for a change in the Work schedule, the Contract Administrator will provide any additional directions in writing detailing the procedures that will be used to resolve the request, including provision of time impact or manpower and equipment loading schedules. Where JEA and the Company are unable to reach a mutually acceptable resolution of request, JEA will make a commercially reasonable determination, made in accordance with JEA's Procurement Code, which shall be final.

2.18. MISCELLANEOUS PROVISIONS

2.18.1. AMBIGUOUS CONTRACT PROVISIONS

The parties agree that this Contract has been the subject of meaningful analysis and/or discussions of the specifications, terms and conditions contained in this Contract. Therefore, doubtful or ambiguous provisions, if any, contained in this Contract will not be construed against the party who physically prepared this Contract.

2.18.2. APPLICABLE STATE LAW; VENUE; SEVERABILITY

The rights, obligations and remedies of the parties as specified under the Contract will be interpreted and governed in all respects exclusively by the laws of the State of Florida without giving effect to the principles of conflicts of laws thereof. Should any provision of the Contract be determined by the courts to be illegal or in conflict with any law of the State of Florida, the validity of the remaining provisions will not be impaired. Litigation involving this Contract or any provision thereof shall take place in the State or Federal Courts located exclusively in Jacksonville, Duval County, Florida.

2.18.3. CUMULATIVE REMEDIES

Except as otherwise expressly provided in this Contract, all remedies provided for in this Contract shall be cumulative and in addition to and not in lieu of any other remedies available to either party at law, in equity or otherwise.

2.18.4. ENTIRE AGREEMENT

This Contract constitutes the entire agreement between the parties. No statement, representation, writing, understanding, or agreement made by either party, or any representative of either party, which are not expressed herein shall be binding. All changes to, additions to, modifications of, or amendment to this Contract, or any of the terms, provisions and conditions hereof, shall be binding only when in writing and signed by the authorized officer, agent or representative of each of the parties hereto.

2.18.5. EXPANDED DEFINITIONS

Unless otherwise specified, words importing the singular include the plural and vice versa and words importing gender include all genders. The term "including" means "including without limitation", and the terms "include", "includes" and "included" have similar meanings. Any reference in this Contract to any other agreement is deemed to include a reference to that other agreement, as amended, supplemented or restated from time to time. Any reference in the Contract to "all applicable laws, rules and regulations" means all federal, state and local laws, rules, regulations, ordinances, statutes, codes and practices.

2.18.6. HEADINGS

Headings appearing herein are inserted for convenience or reference only and shall in no way be construed to be interpretations of text.

2.18.7. INDEPENDENT CONTRACTOR

Company is performing this Contract as an independent contractor and nothing in this Contract will be deemed to constitute a partnership, joint venture, agency, or fiduciary relationship between JEA and Company. Neither Company nor JEA will be or become liable or bound by any representation, act, or omission of the other.

2.18.8. LANGUAGE AND MEASUREMENTS

All communication between the Company and JEA, including all documents, notes on drawings, and submissions required under the Contract, will be in the English language. Unless otherwise specified in the Contract, the US

System of Measurements shall be used for quantity measurement. All instrumentation and equipment will be calibrated in US System of Measures.

2.18.9. MEETINGS AND PUBLIC HEARINGS

The Company will, upon request by JEA, attend all meetings and public hearings as required, in any capacity, as directed by JEA.

2.18.10. NEGOTIATED CONTRACT

Except as otherwise expressly provided, all provisions of this Contract shall be binding upon and shall inure to the benefit of the parties, their legal representatives, successors and assigns. The parties agree that they have had meaningful discussion and negotiation of the provisions, terms and conditions contained in this Contract. Therefore, doubtful or ambiguous provisions, if any, contained in the Contract shall not be construed against the party who physically prepared this Contract.

2.18.11. NONEXCLUSIVE

Notwithstanding anything contained herein that may appear to be the contrary, this Contract is "non-exclusive" and JEA reserves the right, in its sole discretion, to retain other companies to perform the Work, and/or JEA may self-perform the Work itself.

2.18.12. NONWAIVER

Failure by either party to insist upon strict performance of any of the provisions of the Contract will not release either party from any of its obligations under the Contract.

2.18.13. REFERENCES

Unless otherwise specified, each reference to a statute, ordinance, law, policy, procedure, process, document, drawing, or other informational material is deemed to be a reference to that item, as amended or supplemented from time to time. All referenced items shall have the enforcement ability as if they are fully incorporated herein.

2.18.14. SEVERABILITY

In the event that any provision of this Contract is found to be unenforceable under applicable law, the parties agree to replace such provision with a substitute provision that most nearly reflects the original intentions of the parties and is enforceable under applicable law, and the remainder of this Contract shall continue in full force and effect. With regard to any provision in this agreement pertaining to damages, equitable or otherwise, it is the intent of the Parties that under no circumstances shall there be recovery for home office overhead. Any damages claimed shall be proven by discreet accounting of direct project costs and no theoretical formula or industry estimating reference manuals shall be permissible.

2.18.15. SUBCONTRACTING OR ASSIGNING OF CONTRACT

Each party agrees that it shall not subcontract, assign, delegate, or otherwise dispose of the Contract, the duties to be performed under the Contract, or the monies to become due under the Contract without the other party's prior written consent.

The assignment of the Contract will not relieve either of the parties of any of its obligations until such obligations have been assumed in writing by the assignee. If the Contract is assigned by either of the parties, it will be binding upon and will inure to the benefit of the permitted assignee. The Company shall be liable for all acts and omissions of its assignee or its Subcontractor.

In the event the Company obtains JEA approval to use Subcontractors, the Company is obligated to provide Subcontractors possessing the skills, certifications, registrations, licenses, training, tools, demeanor, motivation and attitude to successfully perform the work for which they are subcontracted. The Company is obligated to remove Subcontractors from performing Work under this Contract when the Company recognizes that a Subcontractor is failing to work in a manner consistent with the requirements of this Contract, or when JEA notifies the Company that JEA has determined a Subcontractor is failing to work in a manner consistent with the requirements of this Contract.

2.18.16. SURVIVAL

The obligations of JEA and the Company under this Contract that are not, by the express terms of this Contract, to be performed fully during the Term, shall survive the termination of this Contract.

2.18.17. TIME AND DATE

Unless otherwise specified, references to time of day or date mean the local time or date in Jacksonville, FL. If under this Contract any payment or calculation is to be made, or any other action is to be taken, on or as of a day that is not a regular business day for JEA, that payment or calculation is to be made, and that other action is to be taken, as applicable, on or as of the next day that is a regular business day. Where reference is made to day or days, it means calendar days. Where reference is made to workday, workdays, business day, or business days, it means regular working days for JEA Procurement.

2.18.18. TIME OF ESSENCE

For every material requirement of this Contract, time is of the essence.

2.18.19. TITLE TO MATERIALS FOUND

JEA shall retain the title to water, mineral matter, timber and any other materials that the Company, or its Subcontractors, encounters during the excavation or other operations of the Work. The Company shall use or dispose of this material in accordance with the Contract or written instructions from the Contract Administrator. Any materials found in the excavation, or other operations of the Company, that are of archaeological or historical value shall be left in place. The Company shall immediately notify JEA of the find and shall take no further action until directed by JEA.

2.18.20. USE OF JEA CONTRACTS BY THE CITY OF JACKSONVILLE

Where the City of Jacksonville's or its other independent agencies' or political subdivisions' procurement codes all use of JEA contracts, the Company agrees to extend any pricing and other contractual terms to such entities.

2.18.21. WAIVER OF CLAIMS

A delay or omission by JEA to exercise any right or power under this Contract shall not be construed to be a waiver thereof. A waiver by JEA under this Contract shall not be effective unless it is in writing and signed by the party granting the waiver. A waiver by a party of a right under or breach of, this Contract shall not be construed to operate as a waiver of any other or successive rights under, or breaches of, this Contract.

The Company's obligations to perform and complete the Work in accordance with the Contract shall be absolute. None of the following will constitute a waiver of any of JEA's rights under the Contract: approval of payments, including final payment; Certificate of Contract Completion; any use of the Work by JEA; nor any correction of faulty or defective work by JEA.

2.18.22. JEA PROJECT SECURITY PROGRAM

The JEA Project Security Program establishes a coordinated security program and assigns specific security responsibilities for which the Company and/or its Subcontractors shall be responsible at while performing services at existing JEA facilities and upon the substantial completion of new facilities. The programs objectives are 1) to direct all project security activities toward a single goal--no breaches, thefts or vandalism, and 2) to ensure effective coordination and communication of all project security activities with JEA Security.

In general, the Company shall provide on-site JEA security personnel at any time a JEA facility's perimeter is unsecured, including but not limited to, alarms disabled, fences or gates down, traffic flows that require gates to be opened repeatedly and/or for more than one (1) hour of the work day. The Company shall schedule security personnel through JEA Security. Where existing lighting is disabled or otherwise impacted by the Work, the Company shall provide temporary lighting equal to or exceeding that which exists.

Further, the Company shall be responsible for complying with all applicable provisions of Chapter 12 "Security Program" of the JEA Contractor Safety Management Process Safety Requirements, a copy of which may be obtained upon request.

3. TECHNICAL SPECIFICATIONS/DETAILED SCOPE OF WORK

3.1. TECHNICAL SPECIFICATIONS/DETAILED SCOPE OF WORK (APPENDIX A)

Technical Specifications and a Detailed Scope of Work are located in Appendix A of this document.

125-17 Appendix A Technical Specifications.

4. FORMS

4.1. FORMS (APPENDIX B)

Forms required to be submitted with this solicitation are provided in Appendix B or can be obtained on the JEA website at www.jea.com.

**JEA
GREENLAND ENERGY CENTER
FUEL OIL/DEMINERALIZED WATER STORAGE TANK ADDITION
JACKSONVILLE, FLORIDA**

GENERAL CONSTRUCTION

196116.70.0100

**Issued for Bid
July 26, 2017**

**BLACK & VEATCH
JACKSONVILLE, FL**

BLACK & VEATCH
12740 Gran Bay Parkway W, Suite 2140
Jacksonville, FL 32258
Certificate of Authorization No.: 8132

Project Identification	
Title:	Greenland Energy Center – Fuel Oil/Demineralized Water Storage Tank Addition
Address:	6850 Energy Drive, Jacksonville, FL 32256
Specification:	General Construction
Issue Status:	Owner Review
Certification(s)	
	<p>I hereby certify that this specification was prepared by me or under my direct supervision and that I am a duly registered professional engineer under the laws of the state of Florida:</p> <p>Signed: Eugene Bergt Registration No.: 72007</p>

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01100 - General Requirements and Scope of Work

01100.1 Overall Project Description

Greenland Energy Center (GEC) is located in southeast Jacksonville at 6850 Energy Center Drive, Jacksonville, FL 32256 in Duval County. The power plant consists of two nominal 175 MW General Electric (GE) model PG7241 FA (DLN) combustion turbine generators (CTG), designated Units 1 and 2, installed in simple-cycle configuration and currently in Commercial Operation. The site was cleared and developed, including the storm water detention ponds, for ultimate site build out (including future Units 3, 4, 5, 6, and 7).

01100.2 Contractor's Scope of Work

The scope of work specified herein includes improvements to existing fuel oil and NOx injection water systems at JEA's Greenland Energy Center. All work to furnish and erect equipment specified herein shall be provided by the Contractor. The scope of work includes but is not limited to the following.

- Earthwork including clearing and grubbing of the limits of construction.
- Earthen berm spill containment structure, including:
 - Earthen Embankment (fill material available from onsite spoil pile)
 - 60 mil conductive HDPE liner system
 - Drain sumps
 - Drain lines to existing oil/water separator
 - Through berm pipe penetrations
- Tank foundations including
 - Radial grooves for visual leak detection
 - Embedded tank anchor bolts (if required)
 - Tank drain sumps
- Other concrete bases as shown on the Drawings
- Demolition of the existing 20,000 gallon Fuel Oil Storage Tank and provide blind flanges for all piping connections. The foundation will remain in place. Existing instrumentation cables shall be reused and extended to new fuel oil storage tanks.
- Instrumentation, including:
 - Guided Wave radar fuel oil tank level transmitters,
 - Demineralized water tank static pressure level transmitter
 - Fuel oil tanks mechanical local level indicators
- Lightning protection and tank grounding tied into the existing ground grid.
- Tank lighting
- Above grade/below grade piping and valves as to modify the existing fuel oil system including fill piping, return piping, suction piping, and fire water supply piping.
- Pipe supports including concrete sleepers
- Fire detection and suppression equipment including:
 - Control panel,
 - Tank heat detection equipment
 - Manually actuated low expansion foam fire suppression equipment including foam house, foam chamber assemblies, handline hose reel stations, piping, valves, and instrumentation
 - Fire safe, fusible link, automatic shut-off valve assemblies installed on all tank piping connections located beneath the tank overflow connection.
- Finish painting
- Electrical and control wiring

The Contractor shall provide all materials and services to furnish and erect a complete and operational system. Omission by Engineer of specific equipment and services in the above list

shall not relieve the Contractor of his responsibility to provide all materials and services to furnish and erect a complete and operational system as specified herein.

In the event of technical conflicts, errors, or discrepancies, the detailed technical specifications, including this Section 01100 and all higher numbered sections, take precedence over Section 01400, Technical Supplemental Specifications.

01100.2.1 Erosion Control Measures and Stormwater Pollution Prevention Plan

Contractor shall provide a specific Construction Stormwater Pollution Prevention Plan (SWPPP), and shall meet the requirements of the plant Operational SWPPP that will be provided by the Owner. Additional site erosion control devices required for adherence to the SWPPP shall be provided by the Contractor. This includes sedimentation protection of the existing inlets. Any damage caused by the Contractor to the site erosion control devices shall be repaired by the Contractor.

01100.2.2 As-Built Drawings

Contractor shall provide as-built drawings of the locations and elevations of equipment, utilities, structures and fixtures. As-built drawings shall be clear and legible and "red-lined" electronically on the most recent drawing revision. The Engineer will provide AutoCAD files for the Contractor to complete the As-built markups. The Contractor shall return the AutoCAD files to the Engineer with the As-built markups. Hard Copy As-built drawings shall be submitted to the Owner within 14 days of completion of a system or area. As-built markups requiring clarification shall be resolved within 7 days of the Owner's request for clarification. As-Built drawings shall be signed and sealed by the Contractor and the Contractor's Registered Surveyor.

01100.3 Scope of Work Clarifications

01100.3.1 General

Any costs for soil remediation, soil improvements, removal of unknown abnormal underground obstructions or contaminated soil shall be considered additional work, and shall not be included in the initial Contract scope of work or pricing. The Contractor shall assume that on-site material is suitable for general fill.

Normal construction surveys for laying out and controlling the work shall be included in the Contractor's scope of work. Dewatering and shoring of excavation works shall be the responsibility of the Contractor.

JEA Store numbers indicated on the design documents are for reference only to the specified material/assembly, and is not intended to indicate a JEA supplied material/assembly. All materials and assemblies indicated with a JEA Store number shall be provided by the Contractor at the Contractor's expense.

01100.3.2 Safety, Health, and Accident Prevention

Contractor shall take all precautions to protect the safety of its employees and others on the Work Site. Work safety requirements shall comply with JEA Contractor Safe Work Practices Manual dated February 2007, available on-line at:

https://www.jea.com/About/Procurement/Become_a_Vendor/Contractor_Safety/Contractor_Safety_Manual/

01100.3.3 Lines and Grades

Basic horizontal and vertical control points exist on Site as indicated on the design drawings. These points shall be used as datum for Work under this Contract; however, Contractor shall verify that these control points are correct.

Work shall be done to the lines, grades, and elevations indicated on the design drawings. Contractor shall provide suitable equipment and competent workmen who shall locate and lay out the Work.

Work done without being properly located may be ordered removed and replaced at Contractor's expense.

01100.3.4 Preservation of Monuments, Stakes, and Existing Monitoring Wells

Contractor shall carefully preserve monuments, benchmarks, reference points, stakes, and existing monitoring wells. Contractor will be charged with the expense of replacement of such items destroyed and shall be responsible for mistakes or loss of time that may be caused. Permanent monuments or benchmarks subject to removal or being disturbed shall be protected until they can be properly referenced for relocation. Contractor shall furnish materials and assistance for the proper replacement of such monuments or bench marks.

01100.3.5 Final Grading

At the completion of the Work, holes, ruts, settlements, and depressions resulting from the Work shall be filled and graded to match elevations of adjacent surfaces, and areas disturbed by the Work shall be restored to their original condition to the maximum extent practicable and as reasonably acceptable to Owner.

01100.3.6 Utility Conflicts

Contractor is responsible for providing the materials and labor required to resolve conflicts between the structures being installed by Contractor and the existing underground utilities and structures. The Contractor will be provided with the existing "As-Built" Underground Utility drawings, but it is the responsibilities of the Contractor to field verify all utilities.

01100.3.7 Dewatering

If any dewatering is required to support the construction activities within the Contractor's Scope of Work, it shall be the responsibility of the Contractor and shall be performed in accordance with applicable permits, laws, and regulations. Dewatering shall be required for all Work which requires excavation below the groundwater table unless otherwise stated. The Contractor shall furnish all supervision, labor, materials, tools, and equipment required to install, operate, monitor, and maintain dewatering systems in accordance with the design drawings and permit requirements.

The dewatering systems shall be installed, operated, monitored, and maintained in accordance with the requirements of these specifications, the design drawings, the St. Johns River Water Management District (SJRWMD), the State of Florida, Duval County, and other applicable codes and standards. A detailed dewatering plan including identification of where, when, and how dewatering will be performed, calculation of expected dewatering flow, treatment of discharge flow, and demonstration of insignificant impacts to wetlands and offsite water table shall be provided by the Contractor to the Owner. The Contractor will be required to obtain the applicable dewatering permits.

01100.4 Division of Responsibility

The Division of Responsibility Matrix defining the Contractor's scope of supply and the Owner's scope of supply is included at the end of this section and supplements responsibility definition provided throughout the Contract Documents.

Division of Responsibility Matrix			
Engineering, Procurement, and Construction Items	Contractor	Owner	Remarks
Engineering design		X	

Division of Responsibility Matrix			
Engineering, Procurement, and Construction Items	Contractor	Owner	Remarks
Certified AS-BUILT drawings	X		Drawings shall be certified by a Professional Engineer registered in the state of Florida and shall be identified with "AS-BUILT" designation.
Instruction Manuals	X		
Construction specifications		X	
Site acquisition, land purchase, easements, and rights-of-way		X	
Site survey	X(1)	X(2)	(1) As required for construction only. (2) Owner shall provide the overall property survey.
Site Security		X	
Construction power supply	X		Contractor to provide all required temporary facilities and distribution system(s) from the point of Owner supply.
Construction water supply	X		Includes water required for hydro testing. Contractor may utilize on-site supply of potable water at Contractor's cost but must utilize back-flow prevention and metering device to be obtained by Contractor.
Liquid fuel oil for flushing and disposal	X		Owner may elect to keep fuel oil used for flushing if it is determined that it meets or exceeds the combustion turbine manufacturer's minimum quality requirements for injection into the combustion turbine.
Construction sewage and waste disposal services	X		
Construction telecommunications	X		

Division of Responsibility Matrix			
Engineering, Procurement, and Construction Items	Contractor	Owner	Remarks
All construction craft and supervision	X		

01100.5 Drawings

The following listed documents are included in Appendix A and shall be part of the Contract Documents.

Civil & Structural Details		
Drawing No.	Title	Revision
DS-0053	Pipe Embedment Details	4
DS-0064	Typical Guardrail and Stair Rail Conforming to IBC 2003, 2006 & 2009 For Areas Not Accessible to The Public	9
DS-0071	Typical Ladder Details	8

Mechanical Details		
Drawing No.	Title	Revision
DM-0654	Coating System Data Sheets – Coating System 1712	6

Controls & Electrical Details	
Drawing No.	Title
AC06ZV3A	Cable Specification – Type C3
AD06ZVMA	Cable Specification – Type D1
AE03VVMC	Cable Specification – Type EP2
AG06XX1B	Cable Specification – Type GU
AL06XX1A	Cable Specification – Type L1

Other Documents		
Document No.	Title	Revision
GEK 110483C	Cleanliness Requirements for Power Plant Installation, Commissioning and Maintenance	July 2009
E 7.605.2/05.08	Particle Measurement Technology in Practice. From Theory to Application	3 rd Edition, April 2008

The following listed documents are included in Appendix B and shall be part of the Contract Documents.

General Drawings		
Drawing No.	Title	Revision
CUUU-G0000	Fuel Oil & Demineralized Water Supply And Storage – Cover Sheet	0

Civil & Structural Drawings		
Drawing No.	Title	Revision
CSTF-S3000	Grading & Drainage Drawing – Key Plan Layout	0
CSTF-S3030	Fuel Oil Containment – Grading and Drainage Plan	0
CSTF-S3040	Fuel Oil Containment – Geomembrane Liner Plan	
CSTF-S3720	Fuel Oil Containment – Sections and Details	0
CUUU-S5500	Fuel Oil & Demineralized Water Storage Foundation	0
CFOA-S5501	Fuel Oil Storage Tank – Foundation Plan, Sections and Details	0
CFOA-S5502	Demineralized Water Storage Tank – Foundation Plan, Sections and Details	0
CFOA-S5503	Fuel Oil Containment Foundations – Piping Sleepers	0
CFOA-S5504	Fuel Oil Containment Foundations– Miscellaneous	0
CFOA-S6001	Fuel Oil Containment Steel– Miscellaneous	0

Mechanical Drawings		
Drawing No.	Title	Revision
CFPA-M2361	Piping & Instrument Diagram – Fuel Oil Fire Protection	0
CFOA-M2401	Piping & Instrument Diagram – Fuel Oil Supply And Storage	0
CWWC-M2643	Piping & Instrument Diagram – Fuel Oil Containment Area Drain	0
CWSH-M2668	Piping & Instrument Diagram – Demin Water NOx Injection Supply And Storage	0
CFOA-M6000	Fuel Oil & Demineralized Water Supply And Storage – Piping Key Plan, Tie Points And General Notes	0
CFOA-M6001	Fuel Oil Supply & Storage – Piping Plan	0
CFOA-M6002	Fuel Oil Supply and Storage – Piping Plan	0
CFOA-M6003	Fuel Oil Supply & Storage – Piping Sections And Details	0
CWSH-M6010	Demineralized Water Supply & Storage – Piping Plan	0
CWSH-M6011	Demineralized Water Supply & Storage – Piping Sections And Details	0

Controls & Electrical Drawings		
Drawing No.	Title	Revision
CAAA-E0001	Fuel Oil Supply & Storage – Electrical Legend And General Notes	0
CAAA-E0002	Fuel Oil Supply & Storage – Electrical Details	0
CFOA-E3001	Fuel Oil Tanks – Electrical Site Plan	0
CWSH-E3010	Demineralized Water Tank – Electrical Site Plan	0

The following listed documents are included in Appendix C and are reference documents to the Contract.

Black & Veatch Drawings		
Drawing No.	Title	Revision
160167-CGAU-G1000	Plot Plan Drawing	6
160167-CSTF-S3000	Grading and Drainage – Key Plan	8
160167-CSTF-S3001	Grading and Drainage – Plan – Area 1	6
160167-CSTF-S3002	Grading and Drainage – Plan – Area 2	5
160167-CSTF-S3004	Grading and Drainage – Plan – Area 4	8
160167-CSTF-S3005	Grading and Drainage – Plan – Area 5	6
160167-CSTU-S3300	Underground Utilities – Key Plan	8
160167-CSTU-S3309	Underground Utilities – Plan - Area 9	6
160167-CSTU-S3311	Underground Utilities – Plan – Area 11	6
196116-DM-0001	Fuel Oil Supply & Storage – 500,000 Gallon Fuel Oil Tank	0
196116-DM-0002	Demineralized Water Supply & Storage – 800,000 Gallon Demin Water Storage Tank	0

Zachry Electrical Drawings		
Drawing No.	Title	Revision
D013784-100E00001	Area Classification Plan	0
D013784-684E00002	Grounding Plant Area Grounding View Plan	3
D013784-684E00003	Grounding Zone 1 Layout	1
D013784-684E00005	Grounding Zone 3 Layout	1
D013784-684E00009	Grounding Zone 7 Layout	1
M013784-572E023	Fire Alarm & Detection Systems Interface Panel IP-4 Enclosure Details, Bill of Materials and Internal Wiring Diagram	3

Zachry Underground Utility Drawings		
Drawing No.	Title	Revision
D0138784-591L0100	Site Underground Utilities – Overall Zone Layout	1
D0138784-591L0101	Site Underground Utilities – Zone 1	4
D0138784-591L0102	Site Underground Utilities – Zone 2	3
D0138784-591L0103	Site Underground Utilities – Zone 3	3

Other Documents		
Title		

Other Documents						
Title						
Greenland Energy Center Geotechnical Report						

01100.6 Schedule of Submittals

Item No.	Reference Doc./Sec.	Submittal Items	Submittal Dates			
			Calendar		Event	Due Date
	70.0100	General				
1	70.0100	Engineering, Procurement, Shipping, Construction, Inspection and Testing Schedule and Status Report	30	After	Effective Date of this Contract With Monthly Updates	
2	70.0100	Shipping Notice	2	Before	Delivery	
3	70.0100	Recommended Spare Parts List, with Unit Prices and Names of Suppliers, Necessary to Cover a Full Maintenance Cycle	120	After	Effective Date of this Contract	
4	70.0100	Proof Copy of Instruction Manuals	30	Before	Equipment Installation	
5	70.0100	Final Copies of Instruction Manuals	30	After	Equipment Commissioning	
6	70.0100	Certified "AS-BUILT" Drawings	45	After	Substantial Completion	
7	70.0100	Quality Manual, Controlled Copy	30	After	Effective Date of this Contract	
8	70.0100	Subcontractor listing		With	Bid Submittal	
9	70.0100	Inspection and Test Plan	30	After	Effective Date of this Contract	
10	70.0100	Notification of Inspection/Test	14	Before	Test/ Inspection	
	02342	HDPE Geomembrane Liner				
11	02342	Geomembrane manufacturer qualifications and experience with installation and manufacture of HDPE geomembrane liners, including list of projects with owner's name, location, and installation dates.	30	After	Effective Date of this Contract	
12	02342	Manufacturer specifications and data for the Geomembrane Conductive Liner	30	After	Effective Date of this Contract	

Item No.	Reference Doc./Sec.	Submittal Items	Submittal Dates			
			Calendar		Event	Due Date
13	02342	Manufacturer specifications and data of the HDPE Polylock Embedment	30	After	Effective Date of this Contract	
14	02342	Seam Numbering System	7	Before	Installation	
15	02342	Testing Methods that will be utilized	7	Before	Test	
16	02342	Signed test results	2	After	Test	
17	02342	Certification that welding apparatus can maintain proper control of extrudate or wedge temperature, apparatus pressure, welding speed, width of weld, and sheet preheating temperature	7	Before	Field Seaming	
18	02342	Daily Installation Progress Reports		Daily		
19	02342	Seam Quality Control Reports		Daily		
20	02342	Documentation conforming the raw materials comply with the manufacturer's product properties and performance requirements	21	Before	Installation	
21	02342	Manufacturer's documented test results after the liner is manufactured into rolls	21	Before	Installation	
22	02342	Results from test weld seam tests	7	After	Test	
23	02342	Material and installation warranties	7	After	Installation	
	03311	Cast-In-Place Concrete				
24	03311	Results of testing and test reports.	7	After	Tests	
25	03311	Repair methods and materials.	14	Before	Repair activity	
26	03311	Description of bonding method at construction joints and for repairs.	30	Before	Beginning work	
27	03311	Description of curing materials and methods, and water curing plan for water retaining structures. Include procedures for walls and flatwork.	30	Before	Beginning work	
28	03311	Mass concrete placement, curing, and protection plan. Include temperature monitoring procedure.	30	Before	Beginning work	
29	03311	Hot weather procedures for placement, protection, curing, and temperature monitoring of concrete. Include procedures for adverse weather and equipment failures.	30	Before	Concrete placement begins	

Item No.	Reference Doc./Sec.	Submittal Items	Submittal Dates			
			Calendar		Event	Due Date
30	03311	Water stop data and specifications.	30	After	Effective Date of this Contract	
31	03311	Joint filler data and specifications.	30	After	Effective Date of this Contract	
32	03311	Joint sealant data and specifications.	30	After	Effective Date of this Contract	
33	03311	Bonding adhesive data and specifications.	30	After	Effective Date of this Contract	
34	03311	Anchoring adhesive system data and specifications.	30	After	Effective Date of this Contract	
35	03311	Plastic anchor bolt sleeve data and specifications.	30	After	Effective Date of this Contract	
36	03311	Form material data and specifications.	30	After	Effective Date of this Contract	
37	03311	Form coating data and specifications.	30	After	Effective Date of this Contract	
38	03311	Copy of Cement Mill Test Report		With	Mix Proportions and with each new shipment	
39	03311	Copy of Supplementary Cementitious Materials (fly ash, ground granulated blast furnace slag, silica fume, or other) Report		With	Mix Proportions and with each new shipment	
40	03311	Admixture vendor technical data with certification of compatibility for each admixture to be used		With	Mix Proportions	
41	03311	Coarse aggregate data: <ul style="list-style-type: none"> • Source information • Size designation and gradation - identify controlling specification • Nominal maximum size • Dry rodded unit weight • Saturated surface dry specific gravity • Absorption value • Deleterious material content • Abrasion loss • Soundness • Potential reactivity report, when specified • Water soluble chloride content 		With	Mix Proportions	

Item No.	Reference Doc./Sec.	Submittal Items	Submittal Dates			
			Calendar		Event	Due Date
42	03311	Fine aggregate data: <ul style="list-style-type: none"> • Source information • Gradation - identify controlling specification • Deleterious material content • Fineness Modulus • Sand equivalent value • Unit Weight • Saturated surface dry specific gravity • Absorption value • Soundness • Potential reactivity report when specified • Water soluble chloride content 		With	Mix Proportions	
43	03311	Mix design proportions for all components by mass: <ul style="list-style-type: none"> • Cement • Supplementary cement materials • Coarse aggregate • Fine aggregate • Admixtures • Water • Entrained air • Other components. 	30	After	Effective Date of this Contract	
44	03311	Design mix characteristics: <ul style="list-style-type: none"> • Design Strength • Documentation of required average strength by either of the following methods: 1. Historical data method with standard deviation and test records or 2. Trial batch method with trial mix and test data used to determine strength and proportions • Initial Slump • Augmented slump (after addition of high range water reducers) • Temperature • Time initial set • Unit weight – plastic • Unit weight - after set 		With	Mix Proportions	
	05500	Miscellaneous Metals				
45	05500	Material Certifications	30	After	Effective Date of this Contract	
46	05500	Fabrication and Erection Drawings	7	Before	Erection	

Item No.	Reference Doc./Sec.	Submittal Items	Submittal Dates			
			Calendar		Event	Due Date
	05520	Railings				
47	05520	Material Certifications	30	After	Effective Date of this Contract	
48	05520	Fabrication and Erection Drawings	7	Before	Erection	
	05531	Grating				
49	05531	Material Certifications	30	After	Effective Date of this Contract	
50	05531	Fabrication and Erection Drawings	7	Before	Erection	
	09900	Field Applied Protective Coatings				
51	09900	Product data sheets	60	After	Effective Date of this Contract	
52	09900	Surface preparation/coating procedures	60	After	Effective Date of this Contract	
53	09900	Lining/coating inspection/test procedures	60	After	Effective Date of this Contract	
54	09900	Coating system application/repair procedures	60	After	Effective Date of this Contract	
55	09900	Color/coating samples	60	After	Effective Date of this Contract	
56	09900	Painting certification	10	After	Completion of work	
	13902	Fire Protection and Detection Systems				
57	13902	Complete Engineering design drawings for the Fire, initiating and notification system and devices.	30	After	Effective Date of this Contract	
58	13902	Power requirements, kW	30	After	Effective Date of this Contract	
59	13902	Panel location in building and panel internal layout	30	After	Effective Date of this Contract	
60	13902	Shutdown logics	30	After	Effective Date of this Contract	
61	13902	Hose station layout with pressure and flow calculations.	30	After	Effective Date of this Contract	

Item No.	Reference Doc./Sec.	Submittal Items	Submittal Dates			
			Calendar		Event	Due Date
62	13902	Drawings indicating foundation requirements and loads (equipment/valve house footprint; anchor bolt locations, sizes, and materials).	30	After	Effective Date of this Contract	
63	13902	Electrical load requirements, KVA	30	After	Effective Date of this Contract	
64	13902	Wiring and elementary diagrams showing all external power/control/instrumentation connections.	60	After	Effective Date of this Contract	
65	13902	All interface information between the Contractor supplied piping, etc.	60	After	Effective Date of this Contract	
66	13902	Coating and surface preparation specification	60	After	Effective Date of this Contract	
67	13902	Hydrostatic Testing Procedure	60	After	Effective Date of this Contract	
68	13902	Detailed list of instrumentation and control equipment listing manufacturer, model number, range, setpoint, signal level, etc		With	Instruction Manual	
	15243	Piping Expansion Joints - Rubber				
69	15243	Manufacturer's drawings showing dimensions, weights, and materials of construction	30	After	Effective Date of this Contract	
	15263	General Service Valves				
71	15263	Valve and accessory outline with overall dimensions, weights (including operators and accessories), direction of flow, and butt weld end details	30	After	Formal Issue of Valve List.	
72	15263	Factory Valve and Accessory Outline Drawings With all Accessory Equipment Shown. Drawings should include overall dimensions, operator removal clearance, end-to-end dimensions, and direction of flow.		With	Instruction Manual	
73	15263	Sectional drawing showing materials and internal construction		With	Instruction Manual	
	15921	Piping Erection				
77	15921	Fuel Oil System Flushing Plan	60	After	Effective Date of this Contract	

Item No.	Reference Doc./Sec.	Submittal Items	Submittal Dates			
			Calendar		Event	Due Date
78	15921	Demineralized Water System Flushing Plan	60	After	Effective Date of this Contract	
	16410	Junction Boxes				
79	16410	Manufacturer's catalog sheets for junction boxes and all devices mounted in the junction boxes	30	After	Effective Date of this Contract	
	16430	Disconnect Switches				
80	16430	Manufacturer's catalog sheets showing equipment data including fuse manufacturer's name and model number along with fuse curves when fusible disconnects are furnished.	30	After	Effective Date of this Contract	
	16501	Lighting				
81	16501	Manufacturer's catalog sheets with each luminaire type identified per the contract drawings and specifications. Catalog sheets shall include electrical ratings, dimensions, weight, etc.	30	After	Effective Date of this Contract	
	16510	Conductors and Accessories				
82	16510	Manufacturer's catalog sheets with each cable type identified per the specifications. Catalog sheets shall include insulation type, stranding, dimensions	30	After	Effective Date of this Contract	
	16920	Raceway Components and Installation				
83	16920	Manufacturer's catalog sheets of each conduit being used. Catalog sheets shall include conduit weight, material, dimensions	30	After	Effective Date of this Contract	
	16925	Conductors Installation				
84	16925	Cable schedule	20	After	Installation	
	16930	Grounding Installation				
85	16930	Manufacturer's catalog sheets of grounding components and cable per the specifications.	30	After	Effective Date of this Contract	
86	16930	As installed grounding drawings.	20	After	Installation	

Item No.	Reference Doc./Sec.	Submittal Items	Submittal Dates			
			Calendar		Event	Due Date
	16935	Lightning Protection Components & Installation				
87	16935	Complete system Engineering design drawings and data catalog sheets for all materials showing, size, dimensions, arrangement, location, and connections to the ground grid.	60	After	Effective Date of this Contract	
88	16935	Signed system certification as required by local codes and standards.	30	After	Installation Completion	
	17300	Instrumentation				
89	17300	Instrument list (tag, description, drawing references, calibration range, setpoint, etc.)	60	After	Effective Date of this Contract	
90	17300	ISA-format datasheets for all Instruments	60	After	Effective Date of this Contract	
91	17300	Outline drawing showing all dimensions including process connection sizes, tag number/description and model/serial number.	30	After	Effective Date of this Contract	
92	17300	Terminal block layout and terminal nomenclature if applicable.	30	After	Effective Date of this Contract	
93	17300	Calibration Certification/Report if applicable.	14	After	Test/ Inspection	
	17421	Non-Contact Radar Level Transmitters				
94	17421	Outline drawing showing all dimensions including process connection sizes, tag number/description and model/serial number.	30	After	Effective Date of this Contract	
95	17421	Terminal block layout and terminal nomenclature if applicable.	30	After	Effective Date of this Contract	
96	17421	Calibration Certification/Report if applicable.	14	After	Test/ Inspection	
97	17421	Weight of each level transmitter specified in this section.	30	After	Effective Date of this Contract	

Item No.	Reference Doc./Sec.	Submittal Items	Submittal Dates			
			Calendar		Event	Due Date
98	17421	Copies of all applicable service bulletins, application guides, installation updates or other similar documentation for the devices being furnished (or certification that no such documents apply to product being supplied).	30	After	Effective Date of this Contract	
99	17421	Installation details/recommendations for the devices being furnished	30	After	Effective Date of this Contract	
	17465	Pressure Transmitters				
100	17465	Outline drawing showing materials of construction, connection details, overall dimensions, and weight	30	After	Effective Date of this Contract	
	17501	Temperature Transmitters				
101	17501	Outline drawing showing materials of construction, connection details, overall dimensions, and weight	30	After	Effective Date of this Contract	
	18000	Startup and Commissioning				
102	18000	Submit Test Report Forms to Owner's Startup Manager	5	After	Completion of the activity covered by the form	
103	18000	Submit red line markup's of Engineers drawings showing startup, calibration, and checkout changes during commissioning to the Engineer and the Owner's Startup Manager		With	Completed startup/turnover package	
	Q100	General Welding Requirements				
104	Q100	Welding Procedure Specifications (WPS) with applicable Procedure Qualification Records (PQR)	30	Before	Start of Fabrication	
105	Q100	Procedures for storing, issuing, and reconditioning of electrodes, wires, and fluxes	30	Before	Start of Fabrication	
106	Q100	Repair procedures associated with a nonconformance report	5	After	Discovery of Repair	
107	Q100	Visual inspectors' qualifications and certificates	30	Before	Start of Fabrication	
	Q301	Manufacturer's Standard Coating				
108	Q301	Shop drawings that identify shop-applied coating systems	30	Before	Start of Fabrication	

Item No.	Reference Doc./Sec.	Submittal Items	Submittal Dates			
			Calendar		Event	Due Date
109	Q301	Manufacturer's product data sheets	60	After	Effective Date of this Contract	

01400 - Technical Supplemental Specifications

This section contains technical supplemental specifications that provide additional requirements applicable to the work covered under the technical sections which follow this Section 01400.

01400.1 Summary of Applicable Supplementals

The technical supplementals applicable to each technical section are indicated below.

	Technical Section Number	Technical Section Name	Applicable Technical Supplementals
1	2220	Earthwork	D100, D200, Q500
2	2315	Trenching	D100, D200, Q500
3	2342	HDPE Geomembrane Liner	D100, D200, Q500
4	2371	Seeding and Erosion Control	D100, Q500
5	3210	Concrete Reinforcing	Q100, Q500
6	3311	Cast-in-place Concrete	Q003, Q100, Q500
7	3611	Grouting	Q500
8	5500	Miscellaneous Metals	Q003, Q100, Q121, Q320, Q500
9	5520	Railings	Q003, Q100, Q121, Q500
10	5531	Grating	Q003, Q500
11	9900	Field Applied Protective Coatings	Q301, Q303, Q320, Q500
12	13902	Fire Prot and Detect Sys	D100, E000, E100, E220, E230, K100, M200, M801, Q003, Q301, Q320, Q400, Q500, Q501, Q502
13	15225	General Service Pipe	Q003, Q100, Q400, Q500
14	15243	Piping Expansion Joints- Rubber	Q003, Q320, Q400, Q500
16	15263	General Service Valves	M200, Q003, Q301, Q400, Q500, Q501
18	15901	Mechanical Equipment Erection	
19	15921	Piping Erection	Q100
20	16410	Junction Boxes	E100, E210, E520, Q003, Q400, Q500
21	16430	Disconnect Switches	E210, Q003, Q400, Q500, Q502
22	16501	Lighting	E300, Q003, Q100, Q400, Q500, Q501, Q502
23	16510	Conductors and Accessories	Q003, Q500, Q501, Q502

	Technical Section Number	Technical Section Name	Applicable Technical Supplementals
24	16847	Project Completion and Finishing	Q003, Q500
25	16920	Raceway Components and Installation	Q500, Q501, Q502
26	16925	Conductors Installation	Q500, Q501, Q502
27	16930	Grounding Components and Installation	Q500, Q501, Q502
28	16935	Lightning Protection	Q003, Q500, Q501, Q502
29	16940	Lighting Installation	Q500, Q501, Q502
30	17300	Instrumentation	Q003, Q500, Q501, Q502
31	17301	Stainless Steel Tags	Q003, Q500, Q501
32	17421	Non-Contact Radar Level Transmitters	Q003, Q500, Q501, Q502
33	17465	Pressure Transmitters	Q003, Q500, Q501, Q502
34	17501	Temperature Transmitters	Q003, Q500, Q501, Q502
35	17910	Instrumentation and Controls Installation	Q500
36	17920	Instrument Piping and Tubing Installation	Q500
37	18000	Startup and Commissioning	Q500

01400.2 Technical Supplemental Specifications

The technical supplemental specifications follow.

D100 Site Meteorological and Seismic Data (Revised by Project: 28Jun17)

Work shall be designed according to the following building code and site conditions:

General Design Data:	
Building Code	State of Florida Building Code 2014
Site Elevation (Mean Sea Level), ft	30
Wind Design Data:	
Basic Wind Speed, V, Nominal 3 second gust wind speed at 33 ft (10 m) above ground for Exposure C category, mph (m/s)	140
Exposure Category	C

Importance Factor (Wind Loads), I	1.0
Seismic Design Data:	
State of Florida Building Code does not consider seismic loads for buildings.	N/A

D200 Design Ambients and HVAC Criteria

(Source: 10Sep07 - Revised by Project: 02Jun11)

Area Specific Design. The general design ambient air conditions shall be used unless area specific or equipment specific conditions are indicated in the contract documents:

Area	Temperature, °F		Relative Humidity	
	Minimum	Maximum	Minimum	Maximum
General Outdoor Area	7	105	49%	100%

D300 Property Tables

(Source: 25Mar08 - Revised by Project: 02Jun11)

Liquid Fuel Characteristics Table for No. 2 Fuel Oil	
Specific Gravity at 60 °F	0.8 to 0.9
Viscosity, cSt at 100 °F	1.8 to 3.6
Flash Point, °F	120 to 190

Parameter	Demineralized Water
Silica as SiO ₂ , mg/L	< 0.01
Total Dissolved Solids, mg/L	< 0.025
Specific Conductance, µS/cm	< 0.1

E000 Electrical Equipment and System Voltages

(Source: 22May09 - Revised by Project: 22July11)

Power Supply Code	Continuous Voltage (Volts)	Momentary Voltage Dip to X% of Nominal	Frequency (Hz)	Configuration	System Grounding	Transfer to Alternate Source	Max Sym Short-Circuit Amps
LV-2 Low Voltage (Lighting)	480Y/277 Nom 508Y/293 Max 432Y/249 Min	80	60 Nom 61.5 Max 58.5 Min	3-Phase, 4 Wire, Wye (3/N/PE)	Solidly Grounded	N/A	10,000 (3-Ph) 10,000 (L-G)
LV-3 Low Voltage (Power)	208Y/120 Nom 220Y/127 Max 187Y/108 Min	80	60 Nom 61.5 Max 58.5 Min	3-Phase, 4 Wire, Wye (3/N/PE)	Solidly Grounded	N/A	10,000 (3-Ph) 10,000 (L-G)

Power Supply Code	Continuous Voltage (Volts)	Momentary Voltage Dip to X% of Nominal	Frequency (Hz)	Configuration	System Grounding	Transfer to Alternate Source	Max Sym Short-Circuit Amps
UPS-1 UPS Power	120 Nom 127 Max 108 Min	80	60 Nom 61.5 Max 58.5 Min	Single-Phase, 2 Wire (1/N/PE)	Solidly Grounded	Static 1/2 Cycle	10,000 (L-L) 10,000 (L-G)
DC-1 DC Power	125 Nom 140 Max 100 Min	70	N/A	Two-Pole	Ungrounded	N/A	42,000 (P-P)
CP-1 Control Power (AC)	120 Nom 127 Max 108 Min	80	60 Nom 61.5 Max 58.5 Min	Single-Phase, 2 Wire (1/N/PE)	Solidly Grounded	N/A	10,000 (L-L) 10,000 (L-G)

Definitions: N – neutral; PE – protective earth conductor.

E100 Wiring Methods, Cable, and Raceway (Source: 05Feb07 - Revised by Project: 22July11)

E100.1 General Requirements

In general, all devices furnished under these specifications and requiring electrical connections shall be designed for wiring into electrical enclosures with terminal blocks. Terminal blocks shall be furnished for conductors requiring connection to circuits external to the specified equipment, for internal circuits crossing shipping splits, and where equipment parts replacement and maintenance will be facilitated.

Splices will not be permitted.

Unless otherwise specified, one spare normally open and one spare normally closed contact on each control switch and lockout relay shall be wired out to terminal blocks.

All wiring leaving an enclosure shall leave from terminal blocks and not from other devices in the enclosure.

Auxiliary equipment such as terminal blocks, auxiliary relays, or contactors shall be readily accessible. Auxiliary equipment shall be located in compartments, enclosures, or junction boxes in such an arrangement that service personnel will have direct access to the equipment without removal of barriers, cover plates, or wiring.

Terminal blocks for external connections shall be grouped in the instrument and control compartment for easy accessibility, unrestricted by interference from structural members and instruments. Sufficient space shall be provided on each side of each terminal block to allow an orderly arrangement of all leads to be terminated on the block.

Terminal blocks shall not be mounted in compartments containing uninsulated conductors operating at voltages above 1000 volts.

When current transformers are supplied with the equipment furnished under these specifications, a shorting type terminal block shall be installed at an accessible location for each set of current transformers. The shorting terminal blocks shall be the nearest to the current transformers. No other shorting type terminal blocks are required unless specified otherwise. The shorting terminal blocks shall be furnished with white marking strips.

For safety reasons, the current transformer shall be grounded but the grounding shall occur only at the shorting terminal blocks. The grounding conductor shall be identified so that it may be disconnected in the field as required.

Materials containing asbestos shall not be used in any of the wiring devices or cable.

Control conductors 8 AWG and smaller shall be terminated with compression type connectors properly sized for the conductor and the terminal. Terminal connectors for connecting to screw terminals shall be preinsulated ring type or preinsulated snap spade type terminal connectors. Except for internal wiring of factory prewired electronic system cabinets, crimping ferrules with plastic insulating sleeves shall be provided on all stranded control conductors that are to be terminated to compression Type IEC terminal blocks. Conductors for current transformer circuits shall be terminated with preinsulated ring type terminal connectors.

Each terminal block, terminal, conductor, relay, breaker, fuse block, and other auxiliary devices shall be permanently labeled to coincide with the identification indicated on the drawings. All terminals provided for termination of external circuits shall be identified by inscribing terminal designations acceptable to the Owner on the terminal block white marking strips with permanent black ink. All internal wiring terminations shall be identified by printing on conductor identification sleeves. A conductor identification sleeve shall be provided on each end of each internal conductor. Each sleeve shall be marked with the opposite end destination identification using permanent black ink. Conductor identification shall be permanent, unaffected by age, heat, or solvents and not easily dislodged. Adhesive labels are not acceptable.

The arrangement of connections on terminal blocks shall be acceptable to the Owner.

All connections requiring disconnect plug and receptacle type devices shall be provided with factory terminated conductors on each plug and receptacle. Plugs and receptacles shall be factory wired into junction boxes containing terminal blocks for external connections. All conductors on the disconnect portion of plug-receptacle assemblies shall be in a common jacket. The plug-receptacle assemblies shall have provisions for locking the devices together. The assembly shall also be watertight when installed outdoors.

All temporary wiring installed in the factory for equipment testing shall be removed prior to shipment of the equipment.

Reference to NEC means the codes and standards as defined by the USA National Electrical Code, ANSI/NFPA 70.

E100.2 Equipment Safety Grounding (Earthing)

All electrical equipment that is part of an integral shipping unit or assembly shall be furnished with a bare copper grounding pad. The pad shall be suitable for field connection to the station ground grid by others.

Isolated logic system or single-point ground connections required for proper operation of electronic equipment shall be insulated from the equipment safety ground. Such connections will be extended, using insulated cable, to a single termination point suitable for field connections to the appropriate ground system by others.

Electrical equipment requiring grounding provisions shall include all enclosures containing electrical connections or bare conductors with the exception of control devices, such as solenoids, pressure switches, and limit switches, unless such devices require grounding for proper operation.

The raceway system shall not be considered to be a ground conductor except for itself. All metal conduits containing power circuits shall be provided with grounding type bushings and shall be wired together inside enclosures and connected internally to the enclosure grounding pad or grounding bus with bare copper conductor. The grounding bushing ground conductor shall be sized in accordance with NEC or other internationally recognized standard but shall not be less than 8 AWG bare copper conductor.

Ground conductors shall be soft drawn, bare stranded copper strand Class B as defined in NEMA WC 3 (formerly ICEA S-19-81) (or Class II in IEC 60228). All clamps, conductors, bolts, washers, nuts, and other hardware used with the grounding system shall be copper.

E100.3 Electrical Interconnections

All electrical interconnections between devices, panels, and boxes shall use one of the following wiring methods as specified on the table at the end of this section:

Nonarmored Cable. Nonarmored cable which is continuously supported and protected by conduit or installed in cable tray.

The installation of the cable and raceway system shall meet the requirements of NEC or other internationally recognized standard.

E100.4 Cable

Unless otherwise specified on the table at the end of this section, nonarmored cable shall meet the following minimum requirements:

Stranded copper conductors.

Flame retardant cross-linked polyethylene (FRXLPE) or ethylene propylene rubber (FREPR) insulation on power and control cables.

Polyvinyl chloride (PVC) insulation on instrument and thermocouple extension cables.

FR-PVC jacket on all multi-conductor cables.

Minimum size of 16 AWG for control cables.

Minimum size of 14 AWG for power cables.

Minimum size of 20 AWG for instrument

Minimum size of 12 AWG for lighting/receptacle cables.

General service power and control cables, integral to the equipment furnished but not internal wiring of control cabinets or panels, shall be rated for the maximum service voltage but not less than 600 volts.

Cables which are routed through environmental conditions that differ along the cable run shall be selected using the environmental condition that results in the largest cable size.

All instrument cable shall use stranded copper conductors with twisted and shielded pairs or triads. These requirements also apply to instrument cable which is furnished internal to Contractor-furnished equipment.

Shielding of instrument cables shall consist of aluminum-polyester tape and copper drain wire.

Finished cables shall be capable of passing the IEC 60332-3-10 Category C flame test or the IEEE 1202 (70,000 Btu/h) vertical tray flame test. This requirement also applies to multi-conductor control cable and instrumentation cable which are furnished internal to Contractor-furnished equipment including control panels and cabinets.

Single conductor cables used for internal wiring of control panels and cabinets may be installed according to the Manufacturer's standard as to wire size, insulation, and method of termination on internal equipment, except that insulation for all wires shall meet the IEC 60332-1 flame test or the UL 1581 VW-1 flame test.

Additional requirements as defined in each applicable section.

E100.5 Conduit

All conduit interconnections between devices, panels, boxes, and fittings shall be rigid metal conduit which conforms to NEMA C80.1 and UL 6. All conduit connections shall be of the threaded type, and all conduit, couplings, and fittings shall be hot-dipped galvanized steel. The interior and exterior surfaces of all rigid metal conduit, couplings, and fittings shall have a continuous zinc coating with an overcoat of transparent enamel, lacquer, or zinc chromate. Liquidtight flexible metal conduit may be used as long as the length does not exceed 3 feet. All conduit which enters the top of an enclosure or which enters outdoor enclosures shall enter through raintight steel or malleable iron hubs or threaded openings.

All liquidtight flexible metal conduit shall be constructed of continuously interlocked rust resistant metal core. Conduit shall be coated with sunlight resistant thermoplastic jacket. The conduit shall also resist heat, oil, and chemical breakdown and shall be UL listed.

One exterior locknut, one interior locknut, and one bushing shall be provided at the termination of each rigid metal conduit not terminated in a hub.

Grounding type insulated bushings with insulating inserts in metal housings shall be provided on all conduits not terminated in hubs and couplings. Bushings shall be galvanized.

All conduit fittings shall conform to the requirements of UL 514. All liquidtight flexible metal conduit fittings shall be galvanized steel or malleable iron with insulated throat.

Conduit fittings used on outdoor equipment shall be gasketed.

All conduit shall be installed in exposed runs parallel or perpendicular to dominant surfaces with right angle turns made of symmetrical bends or fittings. Conduit shall be supported by means of conduit clamps and clamp-backs.

Moisture pockets shall be eliminated from conduits. If water cannot drain to the natural opening in the conduit system, a hole shall be drilled in the bottom of a pull box or conduit fitting provided in the low point of the conduit run.

E100.6 Not Used

E100.7 Cable Glands

All cable glands shall comply with the requirements for mechanical cable glands as specified in British Standards Institution BS 6121:Part 1. All glands shall be rated IP66 in accordance with IEC 60529. Cable glands terminating Low Smoke and Fume Cable (LSF) shall be provided with LSF seals. Cable

glands selected for use in hazardous areas shall meet the requirements of national and international standards and shall be acceptable to the Owner.

E100.8 Terminations

The capacities of conduit entrances and terminal enclosures for terminating the cables shall be coordinated with the Owner. Final sizes shall be acceptable to the Owner.

The following criteria apply to wiring methods, cable, and raceway specified herein:

Wiring Methods, Cable, and Raceway	
Electrical Interconnections Between Electrical Enclosures, Devices, or Lighting	Nonarmored cable routed in tray and/or conduit
Cable - Additional Requirements	<p>600 volt multi-conductor power and control cable shall supply power to loads at 480 VAC and 250 VDC or less. 600 volt single-conductor power cable shall have FR-XLPE insulation with no jacket (UL Type RHH/RHW-2/USE-2) or FR-EPR insulation with CSPE jacket. 600 volt multi-conductor power and control cable shall have FR-EPR or FR-XLPE insulation with flame-retardant PVC jacket.</p> <p>All cables shall be UL listed for tray installation.</p> <p>Instrument cable shall be twisted shielded pairs or triads with 300 volt class insulation (minimum). This cable shall have XLPE or PVC insulation with flame retardant PVC jacket (minimum). Single and multiple pairs shall have an overall shield. Multiple pairs shall also have pairs shielded.</p>

E210 Electrical Enclosure Assemblies

(Source: 14Apr04 - Revised by Project: 22July11)

E210.1 General Requirements

Electrical enclosures shall be in accordance with the tables at the end of this section and the following.

Electrical enclosures constructed from steel plate shall be reinforced as required to provide a true surface and adequate support for devices mounted thereon. Enclosures shall be of adequate strength to support mounted components during shipment.

Junction boxes and pull boxes shall be provided without knockouts.

All junction boxes or pull boxes 4 inch trade size or smaller in any dimension shall be galvanized malleable iron or acceptable equal cast ferrous metal.

If epoxy coatings are specified, the coating shall consist of a coat of zinc rich epoxy primer followed by a finish coat of epoxy.

All enclosures shall be manufactured from materials that will not degrade when subjected to sunlight.

Hazardous area enclosure assemblies manufactured to IEC standards shall have a CENELEC Certification Code marked on the enclosure.

In applications where cable glands will be used, electrical enclosures shall have sufficient cable glanding plates to accommodate all cables entering the enclosure.

Junction boxes, electrical control panels, and cabinets shall be provided with an identification nameplate mounted on the front of the enclosure. The nameplate inscription shall be acceptable to the Owner.

E210.2 Electrical Enclosure Heating

Where electrical enclosure heating is specified, electrical space heaters, one adjustable thermostat, one fuse and fuse block or circuit breaker or other means of disconnect shall be provided completely wired in the enclosure. The space heaters, thermostat, and circuit disconnect device shall not interfere with normal cable entrance into the enclosure or with maintenance or replacement of devices within the enclosure. Normal use of space heaters shall not change or discolor any painted surface.

Unless otherwise indicated, the operating range of the thermostat shall be coordinated with the project ambient temperature conditions.

Space heater capacity shall be as required to maintain the enclosure internal temperature above the dew point under the specified site conditions.

Space heater sheaths shall be of a corrosion-resistant, nonoxidizing material.

Electrical Enclosure Assemblies				
Location	Classification	NEMA Std. 250	IEC 60529	Materials
Indoor Dry	Nonhazardous	Type 12	IP52	Galvanized sheet steel
Indoor Wet or Outdoor	Nonhazardous	Type 4	IP55	Copper free aluminum
Wet-Chemical Corrosive	Nonhazardous	Type 4X	IP55	Fiberglass reinforced resin

Enclosure Space Heaters	
Rated Voltage	240 volts ac
Power Source	
Power Supply Code	LV-3
Voltage	120 volts

E220 Electrical Equipment in Hazardous Areas

(Source: 27Jan04 - Revised by Project: 22July11)

All electrical equipment and devices located in areas subject to hazardous area classifications shall be furnished with a nameplate stating the equipment classification. The nameplate data shall include the Class or Zone, Division, Group, and Operating Temperature Designations as applicable to the design standard used to classify the areas. Classification identification nameplates and attachment pins shall be corrosion-resistant metal.

E230 Control Panel Lighting and Receptacles

(Source: 20May11 - Revised by Project: 22July11)

Where control panels are specified, the following lighting and receptacles shall be provided in the control panel. This includes Contractor furnished control panels.

Wiring Devices					
Description	Rated Voltage	Frequency	Ampacity	Configuration	Grade
Receptacle	120	60 Hz	20 A	NEMA 5-20R	Industrial
Light Switch	120	60 Hz	20 A	Single pole or interlocked w/door	Industrial

Lighting						
Application	Fixture	Lamp	Ballast	Rated Voltage	Frequency	Illumination
Control Panel Interior	Fluorescent	T-8	Electronic	120	60 Hz	30-fc

E300 Electronic Systems and Components

(Source: 14Apr04 - Revised by Project: 22July11)

Internal wiring of factory prewired electronic systems in cabinets may be installed according to the Manufacturer's standard as to wire size, insulation, and method of termination on internal equipment except that insulation for all wiring shall meet the IEC 60332-1 flame test or the UL 1581 VW-1 flame test. Conductor identification may be done by insulation color coding noted on the drawings or by printed wiring lists.

The electronic systems shall be tested and verified capable of providing surge withstand capability in accordance with the requirements of ANSI C37.90.1.

All electrical equipment containing electronic logic systems shall be tested in accordance with the manufacturer's standard tests for a minimum of 48 hours under power prior to shipment from the factory. The system shall be tested as a complete assembly. Testing of individual components or modules will not be acceptable as system tests. The system test shall include a means of confirming the logic or mathematical design response of the system by simulating changes in system input. The test shall verify correct operation of the system at both high and low power source voltage limits.

E510 Molded Case Circuit Breakers

(Source: 14Apr04 - Revised by Project: 22July11)

Unless otherwise specified, molded case circuit breakers used in equipment furnished under these specifications shall have a symmetrical RMS ampere interrupting capacity equal to or greater than the maximum short-circuit current values specified on the E000 Electrical Equipment and System Voltages Supplemental Specification for the appropriate Power Supply Code.

The breakers shall have a thermal magnetic type trip and shall be in accordance with UL 489 or IEC 60947-2. In addition to the ac interrupting ratings, all single-pole breakers, 2-pole breakers, and 3-pole breakers shall have the following minimum dc interrupting ratings:

Single-pole breakers	10,000 amperes at 125 volts dc
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Single-pole breakers	10,000 amperes at 125 volts dc
2-pole breakers	10,000 amperes at 250 volts dc
3-pole breakers	10,000 amperes at 250 volts dc

If the Power Supply Code is not specified at the time of contract, the Contractor shall furnish, at no additional charge, molded case breakers that meet or exceed system short-circuit requirements as determined during detailed design.

E520 Terminal Blocks and Fuse Holders

(Source: 27Jan04 - Revised by Project: 22July11)

E520.1 General

In general, manufacturer standard terminal blocks will be accepted provided they meet the requirements of this specification and quality levels equivalent to the manufacturer's terminal blocks listed in the table at the end of this section. Self-stripping terminal blocks, multiple deck (step type) terminal blocks, and angled terminal blocks will not be acceptable. Screw type terminals suitable for ring lug termination shall be furnished for all current transformer secondary lead connections.

Each terminal block shall be provided with a unique identifier. All terminal points shall have provisions to be uniquely identified on the terminal block white marking strip and, where permitted by the safety codes and standards, shall be without covers. Spare points shall be provided with blank strips that can be field marked with a permanent ink marking pen. Spare (unused) terminals shall be furnished evenly distributed on the terminal blocks for circuit modifications. No fewer than two spare unused terminals shall be furnished for every ten terminals used. Fuses may be mounted on terminal blocks.

Terminal blocks shall be manufactured from materials that will not support combustion. Terminal blocks shall meet the Inflammability Class V0 rating in accordance with UL 94. All terminal blocks, except internal terminal blocks in factory prewired electronic systems cabinets and terminal blocks for thermocouple extension wire, shall be rated for 600 volts or greater. No more than two conductors shall be terminated at one connection point. For terminal blocks interfacing with the Owner's field cabling, one side of the terminal block shall be used by the equipment manufacturer for factory wiring and the other side of the terminal block shall be reserved for the Owner's field cabling terminations.

E520.2 Not Used

E520.3 Strap Screw Terminal Blocks

Strap screw terminal blocks shall be of heavy-duty construction capable of terminating a conductor from 16 AWG to 10 AWG. The point-to-point spacing shall not be less than 0.375 inch.

E520.4 Power Terminal Blocks

Power terminal blocks shall be used for conductors 8 AWG and larger.

E520.5 Not Used

E520.6 Fuse Holders for Power Circuits

When fuses rated from 1 to 30 amperes at 250 volts maximum are required, the fuse holders shall be suitable for 30 ampere, 250 volt, Class H cartridge fuses. The fuse holders shall be in accordance with ANSI/UL 521, shall have a withstand rating of 10,000 rms symmetrical amperes, and shall have reinforced fuse contact clips.

The bases shall be molded phenolic, polyester, or other plastic having a Flammability Rating of V-0 when tested in accordance with UL 94. Porcelain, slate, and marble are not acceptable materials for fuse holder bases.

The following criteria shall apply to terminal blocks and fuse holders:

Terminal Blocks and Fuse Holders				
Terminal Block Type	Applications	Acceptable Termination Methods	Acceptable Construction	Acceptable Manufacturers
Feed-Through	DCS I/O and PLC I/O	Compression, Strap Screw	Modular, Rail, Grouped Block, Bolted	Manufacturer's Standard
Feed-Through	General Purpose	Strap Screw	Grouped Block, Bolted, Modular, Rail	Marathon 1500 Series or Owner-Approved Equal
Power	600 Volt Power (8 AWG through 4/0 AWG [10 mm ² through 95 mm ²])	Screw, Compression, Stud	Grouped Block, Bolted	Manufacturer's Standard

E530 Electrical Accessories

(Source: 08Mar10 - Revised by Project: 22July11)

E530.1 Not Used

E530.2 Control Relays

General service auxiliary relays shall be Allen-Bradley Bulletin 700 Type P or Owner approved equal. Where current carrying requirements exceed the capacity of the general service auxiliary relays, auxiliary relays shall be Allen-Bradley Bulletin 700 Type PK, General Electric Type HFA or HGA, Westinghouse Type MG-6, or Owner approved equal.

Timing relays for general service where the delay period is 1 minute or less shall be either pneumatic or solid-state. Timing relays for critical service shall be solid-state. Timing relays shall be Agastat Series 7000 or Owner approved equal.

If the manufacturer proposes the use of auxiliary or timing relays other than the ones listed above, technical data sheets for the proposed relays shall be submitted for approval by the Owner.

Unless otherwise specified, dc relays that interface with the Owner's control system shall have a diode surge suppressor installed across the relay coil.

E530.3 Electrical Switches

Control switches shall be 600 volt, 20 ampere, multistage, rotary type. Unless otherwise specified, switches shall have black, fixed, modern, pistol grip type handles and engraved black plastic escutcheon plates with targets.

Push buttons and selector switches shall be heavy-duty oiltight.

The electrical switches shall be as specified on the E530 Electrical Accessory Devices - Supplemental Requirements sheets.

E530.4 Indicating Lights

Indicating lights for local control stations shall be heavy-duty oiltight and shall permit light changing from the front. Luminous output shall be suitable for the location and ambient lighting conditions. Unless otherwise specified, LED type indicators are preferred on panels.

Indicating light lens colors shall be coordinated with the indicated conditions identified on the E530 Electrical Accessory Devices - Supplemental Requirements sheets. Indicating lights shall be energized when the condition exists and shall be de-energized when the condition does not exist.

E530.5 Contacts

Contact ratings for all electrical accessory devices shall be suitable for interface with the Owner's control system. The Owner's control system interrogation voltages will range up to 230 volts ac and between 24 and 250 volts dc.

All contacts that interface with the Owner's control system shall be electrically "dry." Solid-state switches or triac outputs are not acceptable for contacts that interface with the Owner's electronic control system.

Alarm contacts shall consist of one normally open and one normally closed contact "Form C."

Electrical accessory device contacts, including alarm contacts, wired to the Owner's control system consisting of DCS or PLC I/O cards, shall be suitable for switching currents in the milliampere range for the range of voltages listed above. The electrical accessory device contacts, including alarm contacts, shall allow the Owner's I/O cards to distinguish between a normally open and a normally closed contact.

E530.6 Fuses

Fuses shall be provided with ampere ratings sized for the application. The types and manufacturers of fuses shall be as specified on the E530 Electrical Accessory Devices - Supplemental Requirements sheets.

E530.7 Colors of Indicating Devices and Actuators

Coding of indicating devices and switch actuators (push button, knob, selector switch, or handle) shall be subject to Owner review. If words or recognized abbreviations are required to describe the function of the indicating device or actuator, the language used shall be English. Indicating lights shall be energized when the condition described in the following table exists, and shall be de-energized when the condition does not exist. Unless permitted otherwise in the individual equipment specification, indicating light lens colors and CRT graphic display colors shall be as specified on the E530 Electrical Accessory Devices - Supplemental Requirements sheets.

E530 Electrical Accessory Devices - Supplemental Requirements

Colors of Indicating Devices			
Color	Meaning	Explanation	Examples
Green	Equipment de-energized; process stopped	Normal off condition requiring no action by the operator	Motor stopped; valve (damper) closed; breaker open, contactor de- energized

Colors of Indicating Devices			
Color	Meaning	Explanation	Examples
Red	Equipment energized; process normal	Normal running condition requiring no action by the operator	Motor running; valve (damper) open; breaker closed, contactor energized; process within normal limits; cabinet/panel power available
White	Equipment abnormality; process abnormality	Abnormal condition requiring monitoring and/or intervention by the operator	Motor trip; breaker trip, contactor trip; tripping by a protective device or interlock; electrical lockout relay tripped; position change from normal; pressure or temperature beyond normal limits; overload
White Flashing	Emergency	Dangerous condition requiring immediate action by the operator	Pressure or temperature beyond safe limits; loss of critical process
Blue	Mandatory	Indication of a condition which requires action by the operator	Instruction to enter a value; paralleled electrical power sources to bus causing bus rating to be exceeded
Amber	Permissive	Equipment start permissive; equipment protective relay reset	General information; electrical lockout relay reset

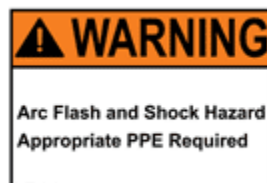
Colors of Actuators		
Color	Meaning	Examples
Red	Emergency	Emergency-stop/off
Black	Normal stop/off	Normal stop; open breaker, contactor de-energized
Black	Normal start/on	Normal start; closed breaker, energize contactor

Electrical Switches		
Application	Description	Manufacturer/Style
Control Switches	Control Panel	General Electric Type SB-1 with large cover General Electric Type SB-10 with large cover Electro-Switch Type 24 Electro-Switch Type W Electro-Switch Type 20K Owner Approved Equal
Push Buttons and Selector Switches	Control Panel or Local	Honeywell Micro Switch Type PT Square D Class 9001 Type K Owner Approved Equal
Toggle Switches	Control Panel	Honeywell Micro Switch Type TL Owner Approved Equal

Fuses and Fuse Blocks	
Application	Manufacturer/Style
Slow Blow Fuses	Owner Approved Equal Gould Shawmut/GDL Bussman/MDL
Fast Acting Fuses	Owner Approved Equal Gould Shawmut/OT Bussman/NON
Extremely Fast Acting Fuses	Owner Approved Equal Bussman/KAB

E530.8 Hazard Warning Labels

The Contractor shall furnish generic labels warning of arc flash and shock hazard, requiring appropriate personnel protection equipment (PPE) to be worn. The labels shall be in accordance with National Electrical Code (NEC) 110.16 Flash Protection and shall be furnished for all medium voltage (MV) and low voltage (LV) switchgear, panel boards, control panels, and motor control centers. The labels shall be located in a clearly visible area at each point of access to the equipment. Equipment access includes but is not limited to breaker, starter, rear access, panel board, and auxiliary compartment doors. Labels provided shall be in accordance with ANSI Z535.4 and either one of the examples below:



Signs shall use black lettering and border on white background. The top banner background shall be orange for Warning signs and red for Danger signs, in accordance with safety colors defined in ANSI Z535.1.

K100 Instrumentation

(Source: 30Mar2011 - Revised by Project: 02Jun11)

K100.1 General Requirements

Unless specified otherwise in other sections, all instrumentation components furnished with equipment shall be in accordance with the following articles.

All instrumentation shall be provided with a stainless steel tag, engraved with the Owner instrument tag number and the service legend, which shall be attached with rivets or stainless steel wire.

All instruments requiring electrical wiring shall be provided with threaded connections to either 3/4 inch (preferred), 1/2 inch conduit or gland seal as appropriate.

Electrical housings shall be dustproof and moisture-proof in accordance with NEMA 4 or NEMA 4X (IP65) requirements or, if they are installed in a hazardous area, shall be of a design suitable for the specific area classification.

Components of the instrument that contact the process media shall be stainless steel or a material suitable for service approved by the Engineer. Coatings shall not be considered adequate protection to resist process corrosion.

Pressure and differential pressure measuring instruments for corrosive or thick, plugging process fluids shall be equipped with a flanged or threaded remote diaphragm seal assembly complete with flushing connection. The seal diaphragm and housing material shall be suitable for the service required. Pressure instruments shall be capable of withstanding sustained over-pressurization to 150 percent of the maximum service pressure, or the system design pressure, whichever is greater, with no subsequent loss of function or change in measurement accuracy.

The process connection on each pressure instrument shall be 1/2 inch MNPT for bottom connection static pressure indicators, at least 1/4 inch FNPT for draft differential pressure devices, and at least 1/4 inch FNPT for all others.

Instruments shall be calibrated in the factory. Calibration ranges shall be suitable for the process conditions. The instruments shall be calibrated so that the normal readings fall somewhere near two-thirds of the calibrated span. Certified calibration sheets shall be furnished for each instrument with a copy included with shipment of each device and in the instruction manual.

Contact ratings shall be as specified in Section E530, Article E530.5 Contacts.

For instrumentation that is supplied skid mounted or installed on package equipment, the instrument installations shall be designed for maintenance and local display viewing accessibility without the use of ladders or scaffolds. For skids that require freeze protection of the instrumentation by the Owner, space shall be provided to install insulation and freeze protection boxes around the instruments and tubing.

The Contractor shall furnish, as a deliverable, ISA-format datasheets for all instruments to the Owner.

K100.2 Local Indicators

Each local indicator shall have the service legend engraved on the dial or have a tag, engraved with the Owner instrument tag number and the service legend, attached to it. Each tag shall be engraved laminated phenolic or stainless steel. Legend and tag number will be provided by the Engineer.

The scale range of each indicator shall be selected so that the normal operating condition is approximately mid scale (between one third and two thirds of full scale of the dial). Except for pressure

differential gauges, rotary type indicator full scale pointer travel shall be a minimum of 270 degrees. Indicator dial size shall be at least 4-1/2 inches. Accuracy of pressure indicators shall be ± 0.5 percent of full scale range. Accuracy of temperature indicators shall be ± 0.1 percent of full scale range.

Differential pressure indicator full scale pointer travel shall be at least 80 degrees. Indicator dial size shall be at least 4 inches. Accuracy shall be 2 to 4 percent of full scale range.

K100.2.1 Level Indicators

Tank level indicators shall be mechanical float and cable type, with cable tensioned automatically maintained by the local indicator. The cable and float shall enter the tank through the top and the local indicator shall be installed at a location providing convenient access to an operator standing at ground level.

K100.2.2 Not Used

K100.3 Not Used

K100.4 Not Used

K100.5 K100.6 Level Transmitters

Level transmitters shall be as specified in the Instrument List and on the electrical drawings.

Q003 Quality System Requirements

(Source: 21Jan10 - Revised by Project: 02Jun11)

This Supplemental Specification establishes the quality management system requirements for suppliers of equipment and commodities.

Q003.1 Quality System

It is the Contractor's responsibility to define and implement a detailed and documented quality management system which ensures that all equipment and commodities supplied are in conformance with required drawings and/or specifications. The Contractor shall meet all the guidelines (requirements) set forth in this document. The quality management system shall be capable of providing assurance that design, purchasing, materials, manufacturing, examination and testing of equipment, shipping, storage, and related services comply with the Contract requirements.

The Contractor's quality management system shall include, at a minimum, procedures and/or methods that ensure the following processes are controlled:

Design documents, drawings, specifications, procedures, inspection and test status and procurement documents are current, accurate, and controlled.

Materials, equipment, and services conform to the requirements of the Contract.

Receipt inspection, in-process inspection, examination, testing, checkouts, and final acceptance testing are conducted.

Shipping, storage, and preservation of equipment and commodities are adequate to prevent damage during delivery and storage of the equipment.

Quality system requirements are passed on to subtier suppliers for subcontracted work, and the Contractor has adequate oversight of subtier supplier activities.

Special processes, such as welding, heat treatment, hot forming, bending and nondestructive examination, are monitored.

Personnel performing special processes, such as welding, nondestructive examinations, coatings, heat treatment, etc., are qualified.

Inspection, measuring, and test equipment is appropriately maintained.

Processes exist for the verification, storage, use, and maintenance of client supplied product.

Applicable industry standards (such as ANSI, AGMA, API, ASME, IEEE, AISC, etc.) shall be incorporated into the quality management system. The quality management system shall be made available to the Engineer's Quality Management Services (QMS) Department for review, inspection, and/or audit upon request.

Q003.2 Verification

The Owner shall have access to perform assessments, quality audits, or witness test activities during the manufacturing process and to review applicable records. Owner may designate an authorized agent to perform these activities. The authorized agent may be an employee of the Owner or an outside agency. When an outside agency is designated as an authorized agent for the Owner, such designation shall be in writing with a copy provided to the Contractor. Hereinafter, when the term "Owner's representative" is used, it may also mean the Engineer or the authorized agent.

The following requirements apply for Engineer's inspection at the Contractor's mill, factory, yard, warehouse, or subtier supplier's facilities.

Q003.2.1 Access

The Owner shall have the right to access the Contractor's and subtier supplier's work and related documents at any time during the manufacturing process without delaying the schedule. The Contractor shall provide, without cost, reasonable facilities including tools, personnel, and instruments for demonstrating acceptability of the work.

Q003.2.2 Control of Special Processes

The Contractor shall ensure that personnel are qualified in accordance with industry standards to perform special processes such as welding, nondestructive examination (NDE), coating, painting, etc. If special processes were conducted by unqualified employees, the Engineer has the option to validate and test the product at the Contractor's expense and/or reject the product.

Q003.2.3 Corrective Action

Upon identification of a noncompliance with the requirements of the Contract, the Contractor shall document the noncompliance issue. For noncompliance issues where the nonconforming characteristic can be restored to a condition such that the capability of an item to function reliably and safely is unimpaired, even though that item still does not conform to the original requirement, the Contractor shall submit the noncompliance to the Engineer for approval.

During witness and hold point activities, if the Owner's representative identifies a noncompliance issue, the Contractor shall document the noncompliance issue and provide a copy of the report to the Owner's representative. If the Contractor disagrees and does not document the noncompliance, the Owner's representative shall issue a corrective action report to the Contractor for disposition and action. The Contractor shall correct, in a timely manner, all deficiencies identified.

Q003.2.4 Rejection

If any items or articles are identified as not meeting the requirements of the specifications, the lot, or any faulty portion thereof, may be rejected. Before offering specified material or equipment for shipment, the Contractor shall inspect the material and equipment and eliminate any items that are defective or do not meet the requirements of the Contract. The fact that equipment or materials have been previously inspected, tested, and accepted does not relieve the Contractor of responsibility in the case of later discovery of flaws or defects.

Q100 General Welding Requirements

(Source: 06Jan10 - Revised by Project: 02Jun2011)

Unless otherwise specified, the applicable governing edition and addenda to be used for all references to codes or standards specified herein shall be interpreted to be the jurisdictionally approved edition and addenda. If a code or standard is not jurisdictionally mandated, then the current edition and addenda in effect at the time of (contract or specification) approval shall govern.

Q100.1 General

Section Q100 shall be used in conjunction with the other Welding Technical Supplemental Specification sections.

Any conflict identified between the requirements of this Welding Technical Supplemental Specification and the provisions of any applicable industry standard, code, regulation, or any specification, standard, or purchasing document contractually required for a given application shall be referred to Owner for resolution prior to the start of welding.

Where requirements of a referenced code or standard differ from the Welding Technical Supplemental Specification sections, the more stringent or restrictive requirements shall apply.

Any request for deviation from specified requirements shall be submitted in writing and shall include the proposed deviation, rationale for the deviation, any technical data supporting the deviation, and historical experience supporting the deviation.

Q100.2 Welding Processes

Unless otherwise specified, only shielded metal arc welding (SMAW), gas metal arc welding (GMAW), flux cored arc welding (FCAW), submerged arc welding (SAW), plasma arc welding (PAW), stud welding, and gas tungsten arc welding (GTAW) processes shall be permitted within the restrictions or limitations specified in the applicable Welding Technical Supplemental Specification section. Other welding processes may be used, provided the governing code or standard permits it and written approval has been granted by Engineer.

Any limitation or restriction specified for GMAW short-circuit arc transfer or a variation of GMAW short-circuit arc transfer marketed by welding equipment manufacturers shall be applied the same, whether a constant voltage (CV) power supply or other power supply developed by a welding equipment manufacturer is used.

Q100.3 Welding Procedure Qualification

Welding procedures shall be prepared and qualified in accordance with the referenced code. Unless otherwise specified, each manufacturer or contractor is responsible for conducting the tests required by the referenced code to qualify the Welding Procedure Specification (WPS).

Welding procedure qualification with GMAW short-circuit arc transfer using a CV power supply shall not qualify a welding procedure for GMAW using a controlled variation of short-circuit arc transfer by a power supply other than CV or vice versa.

WPSs and applicable Procedure Qualification Records (PQRs) shall be submitted for review by Engineer prior to start of fabrication. Submittal of welding procedures and applicable PQRs shall apply to all suppliers and subsuppliers. Suppliers shall review the documents in accordance with the applicable code and specification requirements and shall accept all of their subsuppliers' welding procedures and applicable PQRs prior to submitting accepted documents to Engineer.

Because of the number of different alloys within various alloy P-number or S-number groups, WPSs for welding P-number or S-number 8, 10H, and 41 through 49 alloy materials should identify the base materials by the Unified Numbering System (UNS) or alloy type to aid in the proper application of the WPS, e.g., P45 (UNS N08367, AL6XN). As an alternative to identifying the UNS number on the WPS, the UNS number of the base material or alloy type from the WPS may be cross-referenced to the WPS by other means.

Standard Welding Procedure Specifications (SWPSs) produced by the American Welding Society (AWS) may be used when permitted by the jurisdictional code. Any supplemental requirements mandated by the jurisdictional code shall be met.

Q100.4 Welder/Welding Operator Performance Qualification

Welders and welding operators shall be qualified in accordance with the referenced code. The welder and welding operator qualification records shall be available at the shop facility or construction site and shall be made available for review when requested.

Field personnel not qualified and certified as welders or welding operators are prohibited from performing any welding activities such as tack welds, temporary welds, permanent welds, manufacturing aids, tools, fixtures, or other welded items. The only field personnel not qualified or certified as welders or welding operators who are permitted to perform welding are personnel completing welding training or performing welding performance qualification testing required by the applicable referenced code or specification.

Shop personnel not qualified and certified as welders or welding operators are prohibited from performing any welding activity on materials designated for permanent or temporary installation by the contract, such as tack welds or temporary welds.

Welders and welding operators qualified for GMAW short-circuit arc transfer using a CV power supply shall not qualify a welder or welding operator for GMAW using a controlled variation of short-circuit arc transfer by a power supply other than CV or vice versa.

Each manufacturer or contractor is responsible for the qualification of welders or welding operators. Welder or welding operator performance qualification testing shall be performed under the full supervision and control of the manufacturer or contractor.

Q100.5 Filler Materials

Welding filler metal shall comply with the requirements of the referenced code and any modified requirements specified herein. The filler metal shall be as specified in the applicable WPS.

Unless otherwise specified, the welding filler metal for welding similar base metal types shall have a chemical composition as similar as possible to the base materials to be welded. The finished weld as deposited, or after postweld heat treatment (PWHT) when required, shall be at least equal to the base metal's minimum specified properties or characteristics as they pertain to strength, ductility, notch toughness, corrosion-erosion resistance, or other physical or thermal properties.

Unless otherwise approved in writing, the GTAW or PAW process shall require the addition of filler metal.

Unless otherwise specified or permitted by an approved deviation request, the use of the -G electrode/wire classification is prohibited. When permitted, welding procedures specifying "G" classification consumables shall be restricted to the same manufacturer and brand-name consumable used to weld the procedure qualification test coupon. The manufacturer and brand name shall be listed on the WPS and PQR. The manufacturer's standard, including the mechanical properties and chemical analysis, along with the request for using non-AWS classification or "G" classification consumables shall be submitted to Owner prior to fabrication.

SAW multipass weld deposits shall use an essentially neutral flux for welding carbon steels. Alloy, semiactive, or active fluxes shall not be used except as specified otherwise. Fluxes that compensate for losses of alloying elements are permitted. Active flux may be used for single pass welding of carbon steels, provided the weld deposit thickness is approximately 1/4 inch maximum each side for a double-V-groove joint design or approximately 1/4 inch one side for a single-V-groove joint design. The joint thickness shall not exceed 1/2 inch nominal.

When using the SAW process, the flux listed in the WPS is restricted to the specific brand-name flux used in the welding procedure qualification test. Any change in the flux brand name or designation shall require a new welding procedure qualification. For SAW welding of stainless or nickel-base alloy materials, only those fluxes specified by the flux manufacturer as suitable for the particular type of high alloy electrode to be used are permitted.

The SAW process shall not use recrushed slag.

SMAW low-hydrogen type electrodes, including stainless steel and nickel and nickel alloy electrodes, shall be purchased in hermetically sealed or vacuum packed containers only.

Q100.5.1 Filler Material for Welding Miscellaneous Materials

Unless otherwise specified, filler material selection shall be in accordance with the following requirements.

Q100.5.1.1 Filler Materials for Steel and Low Alloy Steel. For the SMAW process, all filler metal shall be of the low-hydrogen type when welding on either carbon steel or low alloy steel materials. Nonlow-hydrogen type electrodes (E6010 or E7010-A1 only) may be used only for root pass welding on carbon steel piping, unless otherwise specified by other Welding Technical Supplemental Specification sections. SMAW low-hydrogen type ferrous electrodes for all fill passes shall have a minimum tensile strength of 70,000 psi (495 MPa) as defined by the applicable SFA or AWS specification. When welding is required for existing unknown carbon steel materials, the carbon content shall not exceed 0.30 percent or 0.40 percent carbon equivalent (CE) as determined by $CE = C\% + (Mn\%/6 + Si\%/6)$.

For the FCAW process when welding carbon steel materials, only AWS filler metal Classifications E7XT-1, -5, -9, -12 with shielding gas shall be used (current AWS classifications also utilize either an "M" or "C" after the final digit).

Low alloy FCAW electrodes of nominal composition 2-1/4 Cr - 1 Mo and higher for use on pressure-retaining components shall be purchased with a diffusible hydrogen designation of H4 maximum (SFA-5.29).

Q100.5.1.2 Filler Materials for Dissimilar Material Welds. Filler metals for welding pressure retaining component materials of carbon steel or low alloy steel to austenitic stainless steel shall be in accordance with the following:

Service $\leq 500^{\circ}$ F (260 $^{\circ}$ C)	Service $> 500^{\circ}$ F (260 $^{\circ}$ C)
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ASME Specification	AWS Classification	ASME Specification	AWS Classification
SFA 5.9 or SFA 5.14	ER309 or ER309L ERNiCr-3	SFA 5.14	ERNiCr-3
SFA 5.4 or SFA 5.11	E309 or E309L ENiCrFe-3	SFA 5.11	ENiCrFe-3
SFA 5.22	E309TX-X or E309LTX-X	N/A	N/A

Where carbon steel or low alloy steel piping is to be welded to austenitic stainless steel components, and the carbon or low alloy steel piping is of such a thickness as to require PWHT, the end of the carbon or low alloy steel pipe shall be buttered with Type 309L, ERNiCr-3, or ENiCrFe-3 filler metal for system service $\leq 500^{\circ}$ F and shall be buttered with Type ERNiCr-3 or ENiCrFe-3 filler metal for system service $> 500^{\circ}$ F ; the buttered end shall be postweld heat treated. The buttering thickness shall be 3/16 inch minimum after final surface preparation. The weld joint shall then be made between the austenitic stainless steel and the buttering on the carbon or low alloy steel as applicable. This joining method is applicable only to groove welds unless written approval has been granted by Engineer.

Q100.5.1.4 Filler Material for Welding 300 Series Stainless Steels. Filler metal for welding austenitic stainless steel, ASME P-number 8 or S-number 8 base materials shall be in accordance with the following*:

Base Material Type/Grade 304 shall use Type 308 or 308L filler metal.

Base Material Type/Grade 304L shall use Type 308L filler metal.

Base Material Type/Grade 316, shall use Type 316 or 316L filler metal.

Base Material Type/Grade 316L shall use Type 316L filler metal.

*This selection requirement may not apply to cryogenic applications.

When FCAW austenitic stainless steel weld deposits require PWHT or are used at service temperatures $> 1,000^{\circ}$ F (535° C), the electrodes shall have a formulation that does not intentionally add bismuth, and bismuth in the deposited weld metal shall not exceed 0.002 weight percent.

Q100.5.2 Filler Material Control

Storage, handling, and drying of SMAW electrodes and SAW flux shall, as a minimum, be in accordance with the manufacturers' recommendations. In addition, SMAW low-hydrogen type carbon and low alloy steel electrodes shall be stored in ovens at 250° F minimum after the hermetically sealed or vacuum packed container is opened. Bare rod in straight lengths shall be individually flag tagged, stamped, or otherwise identified with the AWS classification or product classification. Each spool of solid or cored rod shall be tagged, labeled, or otherwise identified with the AWS classification or product classification. SMAW low-hydrogen type covered electrodes shall only be reconditioned one time. Any SMAW electrodes that have been wet or have damaged coatings shall not be used. Any welding filler metals or fluxes not readily identifiable shall not be used.

A written procedure for storing, handling, issuing, and reconditioning electrodes, wires, and fluxes shall be submitted for review by Owner.

Q100.6 Fabrication Controls

Q100.6.1 Welding Preheat and Interpass Temperature

The preheat and interpass temperature requirements are mandatory values and shall be in accordance with the referenced code and as specified herein. The WPS for the material being welded shall specify the minimum preheat and maximum interpass temperature requirements. The thickness used to determine preheat requirements shall be the thickness of the thickest part at the point of welding.

The minimum preheat temperature shall be obtained prior to any welding. This shall include tack welding or temporary tack welding.

Preheating shall provide uniform heating over the complete weld or thermal removal process area.

Preheat and interpass temperatures shall be monitored and checked by temperature indicating crayons, thermocouples (TCs), surface contact pyrometers or thermometers, or other suitable methods.

Preheat of pressure retaining components for carbon steel P-number 1 or S-number 1 materials shall be 175° F when the material specified carbon content is in excess of 0.30 percent and the nominal thickness at the joint is in excess of 1 inch. In addition, 200° F minimum preheat is required for nominal thickness over 1.25 inches, regardless of carbon content. A minimum preheat temperature of 50° F is required for all other carbon steel P-number 1 or S-number 1 materials.

The maximum interpass temperature for welding carbon steel and low alloy steel materials shall be 600° F. The maximum interpass temperature for welding carbon steel when impact testing is required shall be 500° F.

The maximum preheat and interpass temperature for stainless steel materials shall be 350° F. The minimum preheat temperature shall be sufficient to ensure that moisture is removed from the material to be welded.

Q100.6.2 Not Used

Q100.6.3 Fabrication Controls for Austenitic Stainless Alloys

The following requirements shall apply when fabricating austenitic stainless alloy components.

Grinding shall be by aluminum oxide, zirconium oxide, or silicon carbide grinding wheels that shall not have been used on carbon or low alloy steels. Hand or power wire brushing shall be by stainless steel brushes that shall not have been used on carbon or low alloy steels. All tools used in fabrication shall be protected to minimize contact with steels or free iron. Grinding wheels and brushes shall be identified and controlled for their use on these materials only to ensure that contamination of these materials does not occur.

To minimize the risk of iron contamination by the inadvertent use of iron contaminated brushes or abrasives, welders and fitters should be instructed not to perform unnecessary wire brushing and abrasive finishing operations.

Antispatter compounds, marking fluids, marking pens, tape, temperature indicating crayons, and other tools shall have a total halogen content of less than 200 parts per million.

Heat input control for welding shall be specified in the applicable WPS and shall not exceed 55 KJ/in. Austenitic stainless steel instrument tubing shall be welded using only the GTAW process.

Socket welds or butt welds in all austenitic stainless steel instrument tubing lines shall require an inert gas backing (purge) using argon during welding to avoid oxidation.

When service conditions require that austenitic stainless steel material maintain its corrosion resistance, the austenitic stainless steel material shall not be postweld heat treated except by solution annealing. If solution annealing is performed, a procedure detailing the solution annealing process shall be submitted for review by Owner prior to performing solution annealing.

For materials that have been contaminated with steels or free iron, Owner may request a ferroxyl test or wet/dry test to identify iron contamination. Iron contamination identified by the ferroxyl or wet/dry test or by other identification means (e.g., visible rusting) shall be removed by mechanical or chemical cleaning. Mechanical cleaning methods, when used, shall be capable of removing the contamination without smearing or redepositing contaminants on the material surface. Chemical cleaning methods, when used, shall be performed in accordance with ASTM A380, Paragraph 6.4 and Annex A2. If requested, a ferroxyl or wet/dry test procedure and cleaning procedure shall be submitted to Owner for review.

Q100.6.4 Miscellaneous Fabrication Control Requirements

Welding shall not be performed when surfaces of the parts to be welded are wet. The parts to be welded shall be protected from deleterious contamination and from rain, snow, and excessive wind during welding.

Prior to welding, the weld preparation and adjacent base material surfaces shall be cleaned and kept free from paint, oil, grease, dirt, scale, rust, and other foreign materials.

The weld end preparation on carbon and low alloy steel materials that will be stored for extended periods of time may consist of coating with deoxaluminum or an equivalent protective material. This coating may be welded through if applied within the manufacturer's maximum weldable limit of 1.25 mils. Complete removal of the coating is neither required nor prohibited, unless signs of rust or other foreign materials such as oil, grease, dirt, or excessive coating are apparent, in which case these areas shall be cleaned.

Acceptable cleaning solvents include new or redistilled acetone (acetone reclaimed by other methods shall not be used), alcohol (ethyl, methanol, or isopropanol), methyl ethyl ketone, or toluene (toluol). Halogenated cleaning solvents shall not be used for cleaning or degreasing.

All groove butt joints shall be complete joint penetration unless specified otherwise by design documents or the applicable code. Partial penetration weld joints not specified by design shall require written approval by Engineer.

Tack welds that are to remain in the completed weld shall have their stopping and starting ends prepared by grinding or other suitable means for satisfactory incorporation into the completed weld. Tack welds that are to become part of the completed weld shall be visually examined; defective tack welds, including cracked tack welds, shall be removed.

When runoff plates are used, they shall be of the same nominal alloy composition as either of the base metals being joined. If runoff plates are used, they shall be properly removed after completion of welding. The method of removal shall not damage the remaining weld or base metal. Runoff plates shall not be knocked off.

Complete penetration joints welded from both sides shall have the root of the first layer or pass chipped, gouged, ground, or machined to sound metal prior to welding from the second side. This requirement is not intended to apply to automated line processes, where the welding from the second side is controlled to provide adequate penetration and ensure full fusion without back gouging.

Welded joints shall be made by completing each weld layer before succeeding weld layers are deposited. Partial fill passes are permitted to correct localized underfill conditions and for the purpose of maintaining alignment. Block welding is prohibited.

As-welded surfaces are permitted; however, the surfaces of welds shall be uniform in width and size throughout their full length. The cover pass shall be free from coarse ripples, grooves, overlaps, abrupt ridges, and valleys. The surface condition of the finished welds shall be suitable for the proper interpretation of nondestructive examination. If the surface of the weld requires grinding to meet the above criteria, care shall be taken to avoid reducing the weld or base material below the minimum required thickness.

All pressure retaining fillet weld joints other than socket welded joints that require a fillet weld size greater than 1/4 inch shall require a minimum of two weld layers, except for those fillet weld joints welded with a mechanized or automatic welding process.

Socket welds shall meet the following requirements within the welding process restrictions and limitations specified in the applicable Welding Technical Supplemental Specification section:

A minimum of two weld layers is required for pipe or tube over 0.200 inch nominal wall thickness.

For pipe or tube 1/2 inch or less in nominal pipe size, the GTAW process shall be used.

Welding slag and spatter shall be removed from all welds.

A gas or gas mixture used for shielding shall be welding grade or shall meet Specification SFA-5.32 and have a dew point of -40° F or lower.

Shop fabricators and suppliers shall check for residual magnetism at each end of the machined field pipe weld bevels. Weld bevels containing residual magnetism greater than 5 gauss shall be demagnetized.

Arc strikes outside of the area of permanent welds should be avoided on any base metal. Cracks or blemishes caused by arc strikes shall be ground to a smooth contour and checked to ensure soundness.

Peening is prohibited. The use of power tools for slag removal is not considered peening.

The application of heat to correct weld distortion and dimensional deviation without prior written approval from Owner is prohibited.

Complete joint penetration welds welded from one side without backing, weld repairs welded from one side without backing, or weld repairs in which the base metal remaining after excavation is less than 0.1875 inch from being through wall, which are fabricated from materials with an ASME P-number of 5B or higher or unassigned metals with similar chemical compositions, shall have the root side of the weld purged with an argon backing gas prior to welding. Unless otherwise specified, backing gas (purge) shall only be argon. The argon backing gas shall be classified as welding grade argon or shall meet Specification SFA-5.32, AWS Classification SG-A. The backing gas (purge) shall be maintained until a minimum of two layers of weld metal have been deposited.

Temporary attachments to pressure boundary components outside the weld bevel groove area should be avoided and only used when absolutely necessary. When required, clamps, welded clips, tack welds, or other appropriate means shall be used to properly align the joint for welding. Welded attachments used for fit-up shall be compatible with the base material and shall be welded with a qualified welding procedure. Attachments shall not be knocked off base material. The attachments shall be removed by

suitable methods, such as grinding, machining, or sawing, followed by grinding flush with the base material. When thermal cutting is used to remove attachments, approximately 3/16 inch of material shall be left for final removal by grinding. The ground area shall then be visually examined for defects. The area from which attachments have been removed shall be examined as required by the governing code or specification. Any defects found shall be repaired.

Welding across the flanges of Owner's structural steel members (welds that are transverse to the beam or column center line) shall not be an acceptable practice, and Contractor shall design all welded interfaces to Owner's steel structure to specifically avoid this condition. Contractor's design of such interfaces shall achieve full required design strength and stability by means other than welds applied across flanges.

All defects in welds or base materials shall be removed and repaired in accordance with the referenced code.

A written procedure for root side purging shall be described in detail and shall be submitted concurrently with the welding procedures for review by Engineer.

Welding machine ground leads and clamps shall be located to avoid passing welding current through equipment, snubbers, bearings, or any other items where transfer of electrical current may result in damage to equipment.

A complete repair procedure for repairs that are documented as the basis of a nonconformance report shall be submitted to Engineer for review and approval in writing prior to performing the repair. If repair by welding is required, the applicable WPSs and supporting PQRs shall be submitted with the repair procedure. All nonconformance report dispositions shall comply with applicable code requirements.

Q100.7 Nondestructive Examination (NDE)

All NDE shall be performed in accordance with the methods specified in the referenced code and any supplemental NDE specified within the other Welding Technical Supplemental Specification sections.

Except for final visual examination, which is required for all welds, the responsible Contractor's Certified Welding Inspector (CWI) shall perform in-process visual inspections at suitable intervals during the fabrication and erection process to ensure the applicable requirements of the referenced code, design specification, and WPS are met. Such inspections, on a sampling basis, shall be performed prior to assembly, during assembly, and during welding.

NDE shall be performed in accordance with written procedures that are prepared in accordance with the referenced code and as specified herein. NDE procedures other than for visual examination shall be approved by a qualified and certified NDE Level III. The NDE Level III approval shall be shown on the NDE procedure. NDE procedures shall be submitted for review by Engineer prior to their use.

NDE personnel performing NDE other than visual shall be qualified and certified for the applicable NDE method. Personnel shall meet written practice ASNT SNT-TC-1A, unless permitted otherwise by the referencing code or prior written approval from Engineer is obtained. NDE personnel qualification records shall be made available for review when requested.

All welds shall receive 100 percent visual examination. Visual inspection of welds shall be performed prior to any painting, coating, or galvanizing. Visual weld examination acceptance criteria and other NDE acceptance criteria shall be in accordance with applicable referenced codes and design documents. Records of these examinations shall be documented.

The NDE results shall be provided in a NDE Report that is evaluated, interpreted, and accepted by a Level II or Level III NDE personnel.

Contractor shall obtain and pay for the services of an independent testing laboratory to provide the required field nondestructive examination. Any defective weld shall be removed, repaired, and retested at the Contractor's expense.

Owner may order NDE by an independent laboratory in addition to any examinations specified herein. The NDE type, extent, and method shall be the same as that required for the original weld. If the weld is defective, the laboratory costs shall be paid by the Contractor. If the weld is not defective, the laboratory costs will be paid by Owner. Repair of defective welds and reexamination shall be at the Contractor's expense. Weld acceptance standards shall be in accordance with applicable codes and design specifications. If an individual interpretation is in question, the final authority shall be the responsibility of Owner.

Q100.8 Records

Records of inspections, NDE, impact testing, hardness testing, PWHT charts or records, base material test reports, filler material test reports, radiographic film with applicable reader sheets, deviation requests including resolution documentation, nonconformance reports, and other records, as required, shall be retained by the Contractor for 5 years after completion of the work. Records shall be submitted to Engineer and/or Owner, if requested.

Quality records, including applicable Data Report Forms generated by a manufacturer or assembler in accordance with an approved Quality Control System, shall be provided in accordance with the approved Contract. Quality records shall be legible, appropriately completed, and sufficiently detailed to permit traceability to the item or activity involved.

Q121 Welding of Carbon, Low Alloy, and Stainless Structural Steel

(Source: 04Feb10 - Revised by Project: 26Jul2011)

Q121.1 General

This Technical Supplemental Specification provides requirements for welding carbon, low alloy, and stainless structural steel, ductwork, stacks, and other welded steel structures as required by design, in accordance with AWS D1.1, Structural Welding Code - Steel or AWS D1.6, Structural Welding Code - Stainless Steel. Supplemental requirements for welding a seismic load-resisting system (SLRS) shall be in accordance with AWS D1.8, Structural Welding Code – Seismic Supplement, when seismic detailing or enhanced ductility is required by design. This Technical Supplemental Specification shall be used in conjunction with Section Q100 of the Welding Technical Supplemental Specifications.

Q121.2 Welding Processes

Permitted welding processes shall be as specified in Section Q100 and shall include the restrictions and limitations applicable to those processes as specified herein.

Q121.2.1 Welding Process Restrictions and Limitations

The Gas Metal Arc Welding (GMAW) process utilizing the short-circuiting transfer mode shall not be used in any application, except for the following:

AWS D1.1 – No exceptions.

AWS D1.6 – When welding base metals that have a maximum thickness of 3/16 inch.

AWS D1.8 – No exceptions.

The Flux Cored Arc Welding (FCAW) process shall only be used with shielding gas, except for the following:

AWS D1.1 – When welding base metals that have a maximum thickness of 1/2 inch and that use E71T-8 electrodes.

AWS D1.6 – No exceptions.

AWS D1.8 – When welding base metals that have a maximum thickness of 1/2 inch and that use E71T-8 electrodes. Furthermore, the electrodes shall meet the impact testing requirements of AWS D1.8, Annex B.

The weld progression for manual or semiautomatic vertical position welds shall be uphill, except for the following:

AWS D1.1 – Undercut may be repaired vertically downward, provided the preheat is in accordance with AWS D1.1, Table 3.2, but not lower than 70° F.

AWS D1.1 – When tubular products are welded, the progression of vertical welding may be upward or downward, but only in the direction in which the welder is qualified and as permitted by the Welding Procedure Specification (WPS).

AWS D1.6 – Using the prequalified Gas Tungsten Arc Welding (GTAW), GMAW-S, and FCAW-G processes, progression may be vertically downward for base metal with a 3/16 inch maximum thickness.

AWS D1.6 – Undercut may be repaired vertically downward on the joint faces only, without any base metal thickness limitations when using the prequalified GTAW and FCAW-G processes. When using the prequalified GMAW-S process, undercut may be repaired vertically downward on the joint faces only for base metal with a 3/16 inch maximum thickness.

AWS D1.8 – AWS D1.1 requirements above shall apply.

Q121.3 Welding Procedure Qualification

Welding procedures shall be prepared and qualified or shall be prepared as prequalified in accordance with the applicable AWS code. All prequalified WPSs shall be in the form of a written document. For a WPS to be prequalified, conformance with all of the applicable requirements of AWS D1.1, Section 3 or AWS D1.6, Section 3 shall be required.

For AWS D1.1 welds, when the base metal is required to be Charpy V-Notch (CVN) impact tested by the design specification or contract documents, the WPS qualification shall include the CVN test requirements of AWS D1.1. The minimum CVN test temperature for the welding procedure qualification shall be at or below the minimum test temperature specified by the design specification or contract documents.

For AWS D1.8 welds (Demand Critical and Non-Demand Critical), CVN testing is mandatory. All WPS qualifications shall be performed in accordance with the CVN test requirements of both AWS D1.1 and AWS D1.8. The minimum CVN test temperature for the welding procedure qualification shall be at or below the minimum test temperature specified by the design specification or contract documents.

When the base metal is required to be CVN impact tested by the design specification or contract documents, the filler metal required by the WPS for welding the CVN base metal shall be classified with CVN impact testing at a test temperature at or below the test temperature specified by the design specification or contract documents.

Q121.4 Welder/Welding Operator Performance Qualification

Welders and welding operators shall be qualified in accordance with the applicable AWS code. As an alternative, welders and welding operators may be qualified in accordance with ASME Section IX within the welding personnel performance essential variable limitations permitted by the applicable AWS code.

For AWS D1.8 welding, the shielding gas for FCAW shall constitute an essential variable and any change shall require requalification.

For AWS D1.8 welding, the qualification for welding personnel using the Supplemental Welder Qualification for Restricted Access Welding shall remain valid for 12 months or the duration of the project, unless there is a specific reason to question the welder's ability.

Q121.5 Fabrication Control

Fabrication, assembly, and erection shall be in accordance with the applicable AWS code and the design documents.

When welds joining ASTM A588 weathering steels will experience exposure to atmospheric conditions and are left exposed, bare, unpainted, uninsulated, or otherwise visually observable in their final service condition, the filler metal required for welding shall comply with the requirements specified in AWS D1.1, Section 3.7.3 and Table 3.3.

When tensile forces are to be transmitted through full penetration groove welds on AISC material Groups 4 and 5 rolled shapes, or shapes built up by welding plates more than 2 inches thick together to form the cross section, the requirements of AISC J1.7 in the AISC 9th Edition or AISC J1.5 and J2.6 in the AISC 13th Edition, as applicable, shall apply.

Q121.5.1 Backing and Retainers

When required, backing shall be in accordance with the applicable AWS code.

Nonmetallic retainers or nonfusing metal retainers shall not be used unless specified in the WPS. When used, they shall be removed.

Q121.5.2 Preheat and Postweld Heat Treatment

For AWS D1.1 prequalified carbon and low alloy steels, preheat shall be performed in accordance with AWS D1.1, Table 3.2, applicable to the materials listed and the design documents. The minimum preheat temperature shall be specified in the WPS.

For AWS D1.6 prequalified austenitic stainless steels, the minimum preheat temperature shall be 50° F. The minimum preheat temperature shall be specified in the WPS.

For AWS D1.1 or AWS D1.6 materials that are not prequalified, the minimum preheat temperature shall be in accordance with the preheat temperature established from the welding procedure qualification. The minimum preheat temperature shall be specified in the WPS.

For AWS D1.8 welding, the maximum interpass temperature shall not exceed 500° F.

When required by design, postweld heat treatment shall be performed in accordance with the applicable AWS code and the design documents.

Q121.5.3 Weld End Preparation

Preparation of butt welding ends of piping components for shop welds shall be in accordance with the fabricator's standard end preparation details and WPS. Preparation of pipe butt welding ends for field welds shall be in accordance with ASME B16.25.

Q121.6 Nondestructive Examination (NDE)

In addition to the 100 percent Visual Examination (VE) required of all welds, other required NDE of welds shall be performed in accordance with the applicable AWS code and the design documents defined herein.

Supplemental VE of welds after galvanizing shall be performed as defined in Article Q121.6.1.1.1.

Unless otherwise specified, any weld defects identified by NDE shall have additional examinations conducted as required by Section 6.15 of AWS D1.1 (including AWS D1.8 welds) or Section 6.8 of AWS D1.6, as applicable. All defects found shall be removed, repaired, and re-examined by the same NDE method that identified the original defect.

Q121.6.1 NDE Requirements of Welds

Structures include buildings and non-buildings, as defined in ASCE 7. Non-building structures similar to buildings will require the same NDE methods as the appropriate building structure type.

Q121.6.1.1 Not Used.

Q121.6.1.1.1 Supplemental Visual Examination Requirements of Welds after Galvanizing. The following welds and immediate adjacent areas (within 1 inch of the weld) shall be 100 percent visually examined by the responsible supplier or responsible contractor that performs the galvanizing not less than 48 hours after completion of galvanizing:

Butt joint splices, columns, and beams.

Beam clip angles.

Plate girder and built-up flexural member joint welds.

All areas requiring VE shall be examined for the presence of cracks. The acceptance criteria for the subject welds shall be "free from cracks."

If any cracks are visually identified after galvanizing, Engineer shall be notified prior to repair. Engineer may request additional NDE by MT examination of any similar joint types. Any cracks discovered by MT, but not previously identified by VE, shall require 100 percent MT examination of all similar joint types at the expense of Contractor. Any cracking detected by VE or MT shall be repaired at the expense of Engineer.

Visual inspection of the subject welds after galvanizing may be performed by personnel other than the responsible Contractor's Certified Welding Inspector (CWI). Personnel other than a CWI must have experience suitable to Engineer for performing post-galvanizing weld visual inspection. Visual inspectors' qualifications and certificates or evidence of training or experience shall be submitted to Engineer for review.

Q301 Manufacturer's Standard Coating

(Source: 11Dec07 - Revised by Project: 02Jun11)

Unless otherwise specified, the manufacturer's standard coating systems shall be applied in the shop to ferrous metal surfaces of equipment and materials. The coating systems shall provide resistance to corrosion caused by weather and industrial environments. Surfaces that will be inaccessible after assembly shall be protected for the life of the equipment.

Coating material and application shall conform to the regulations of the air quality management agency having jurisdiction. Materials shall be formulated to contain less than 0.06 percent lead or chromium in the dried film.

Surfaces shall be cleaned, prepared, and coated in accordance with the coating manufacturer's instructions and specified codes. Surfaces to be painted shall be prepared, as necessary, to provide a smooth, uniform base for painting.

Coating films that show defects such as sags, checks, blisters, teardrops, fat edges, et cetera will not be accepted. Any coated surface that contains any of the previously mentioned defects shall be repaired or, if necessary, entirely removed from the member or unit involved and the surface recoated.

Surfaces to be finish painted after installation shall be shop painted with one coat of manufacturer's standard primer.

Touchup paint shall be provided for repair painting of at least 10 percent of the finish painted equipment surface. The touchup paint shall be the same type and color as the shop applied material. Application instructions shall be provided.

No coating shall be applied to surfaces within 3 inches of field welded connections.

Coating dry film thicknesses shall be measured using a magnetic or electronic thickness detector in accordance with SSPC-PA2. Additional coating shall be applied to all areas which show a deficiency in dry film thickness.

Q301.1 Control and Electrical Equipment

Control and electrical equipment, including panels and cabinets, shall be finish painted. Exterior surfaces shall be the manufacturer's standard color unless specified otherwise. The interior portions of cabinets shall be painted a light reflecting color.

Q301.2 Mechanical Equipment

Mechanical equipment, including valves, valve operators, external piping surfaces, and other similar equipment, shall be cleaned, prepared, and primed.

Q301.3 Documentation

Shop drawings shall identify the shop applied coating systems. Data to be provided shall include the coating system manufacturer's name and product designation, the degree of surface preparation, dry film thickness, finish color, and Material Safety and Data Sheets (MSDS). Final dry film thickness test results shall be submitted to the Owner for verification.

Q320 Galvanizing

(Source: 27Jan04 - Revised by Project: 02Jun11)

Structural steel members and steel assemblies shall be "pickled" after all cutting, punching, reaming, drilling, tapping, and other fabrication processes which would damage galvanizing have been completed.

The pickling shall be done in accordance with the latest accepted practice and shall continue until all scale, rust, grease, and other impurities have been completely removed. The steel shall then be hot-dip galvanized.

When either member to be bolted is galvanized and where required by the detailed specifications, erection and structural bolts shall be galvanized.

ZRC Brush Applied Cold Galvanizing Compound shall be used for touchup of galvanized surfaces in lieu of Cold Galvanizing Spray.

Q320.1 Codes and Standards

Work performed under this specification shall be done in accordance with the following codes and standards. The version that is latest adopted, published, and effective at the date of bid shall apply unless specifically stated otherwise:

Work	In Accordance With
Hot-dip galvanizing	ASTM A123 or ASTM A153
Bolt galvanizing	ASTM B695 Class 50

Q400 General Equipment Requirements

(Source: 14Sep10 - Revised by Project: 02Jun11)

Q400.1 Miscellaneous Materials and Services

Miscellaneous materials and services not otherwise specifically called for shall be furnished by the Contractor in accordance with the following, as applicable:

All nuts, bolts, gaskets, special fasteners, backing rings, etc., between components and equipment furnished under these specifications.

All piping integral to or between any equipment furnished under these specifications, except as otherwise specified.

All necessary connections for the Owner's piping and instruments.

All necessary instrument, power, and control wiring and raceways integral to any equipment furnished under these specifications. This shall include terminal blocks and internal wiring to these terminal blocks for equipment requiring external connection.

Leveling blocks, soleplates, thrust blocks, matching blocks, and shims.

All special tools or lifting beams.

Lifting eyes and lugs for offloading and setting equipment.

Q400.2 Fabrication Restrictions

Unless specifically provided otherwise in each case, all materials and equipment furnished for permanent installation in the work shall conform to applicable standard specifications and shall be new, unused, and undamaged.

Asbestos containing materials will not be allowed.

Flanges, fittings, and valves manufactured in the People's Republic of China shall meet following requirements.

Manufacturer's quality system shall be in accordance with ISO 9001 and the manufacturer shall hold a valid ISO 9001 certificate issued by the certified ISO 9000 certification organization.

Manufacturer shall hold a manufacturer's license issued by the China Special Equipment Inspection & Research Center (CSEI) under General Administration of Quality Supervision, Inspection and Quarantine of the People's Republic of China (AQSIQ).

Products shall have markings as required by ASME B16.1, ASME B16.5, ASME B16.9, ASME B16.10, ASME B16.11, ASME B16.25, or ASME B16.34 as applicable.

The final quality certificate and quality inspection documents shall bear the official stamp of CSEI or AQSIQ or its branches.

Individual parts shall be manufactured to standard sizes and gauges so that repair parts furnished at any time can be installed in the field. Like parts of duplicate units shall be interchangeable.

Q400.3 Nameplates and Tags

Nameplates and tags shall be furnished for all equipment with a Owner's identification number based upon the guidelines provided herein. The Owner will annotate the Contractor's drawings on initial submittals of technical drawings of the equipment. The information will include the nameplate description, tag number, physical size, and lettering height. The type of nameplate will vary because of size constraints, equipment location and/or orientation, or the environment in which the equipment is located.

In general, nameplates shall be furnished for major equipment, including all operator interfaces, control and electrical panels, cabinets, and instrument racks. The nameplates shall be beveled, laminated white phenolic plastic engraving stock with black core or beveled, two-ply vinyl white with reverse engraved black fill. These nameplates shall be 2 inches by 8 inches with three lines of text. The top two lines of text shall be a brief description of the equipment. These lines of text shall be 3/8 inch high. The bottom line of text shall be the Owner's identification number of the equipment. This line of text shall be 3/16 inch high. Nameplates that are to be mounted on equipment to be installed in non air-conditioned areas shall be attached with stainless steel panhead screws, rivetsdrive screws, or epoxy glue. Nameplates that are to be mounted on equipment to be installed in heated and air-conditioned areas shall be attached with high performance adhesive tape. Nameplates shall be 1/16 to 1/8 inch thick.

Stainless steel tags shall be furnished for all field instrumentation, all valves, and other small devices that a plant operator is not likely to have any direct interface with, as directed by the Engineer. These stainless steel tags shall be permanently attached to the equipment with stainless steel panhead screws, rivets, drive screws, or, with the Owner's acceptance, stainless steel wire. The size of these tags shall be a minimum of 1-1/4 inch by 2-1/2 inches 18 Ga thickness and include the Owner's identification number. Lettering shall be stamped or engraved on a polished plate, with text at least 3/16 inch in height. Text shall be sized as large as possible within the size constraints of the tag.

Separate nameplates are not required for pressure indicators. They may be provided instead with nameplate information, as described above, permanently engraved on the faces. Face engraving text size and layout shall be readable without magnification.

Q400.4 Factory Assembly

Equipment shall be shipped completely factory assembled, except when the physical size, arrangement or configuration of the equipment, or shipping and handling limitations make the shipment of completely

assembled equipment impracticable, in which case the equipment shall be assembled and shipped as stated in the Contractor's proposal.

When indicated in the Schedule of Submittals, the Contractor shall submit a Shipping Plan confirming and detailing the field assembly requirements as stated in the proposal.

All separately packaged accessory items and parts shall be shipped with the equipment. Containers for separately packaged items shall be marked so that they are identified with the main equipment. An itemized packing slip indicating what is in that container only shall be attached to the outside of each container used for packaging. A similar list shall be inside each container. A master packing slip covering all accessory items for a given piece of equipment which are shipped in separate containers shall be attached to one container.

Q400.5 Tools

The Contractor shall furnish and ship with each piece of equipment one set of all special tools required for dismantling, maintenance, and overhaul of the equipment. The tools shall be shipped in separate, heavily constructed wooden boxes provided with hinged covers and padlock hasps.

Maintenance tools for each piece of equipment shall be boxed separately and the boxes shall be marked with the name of the project and the name of the equipment.

The maintenance tools shall include all special handling rigs, bars, slings, and cable. All maintenance tools shall be in new and unused condition and shall become the property of the Owner. The bidder's proposal shall include the list of maintenance tools which shall be furnished with the equipment.

Q500 Shop Drawings and Instruction Manuals

This section, in conjunction with the Schedule of Submittals, stipulates the requirements for engineering data that Contractor shall submit for design information and review. Document submittal procedures shall be in accordance with the requirements of this Contract.

Q500.1 Submittal Requirements

Technical data shall be submitted in electronic format. Hard copy prints of the electronic files shall also be submitted, as specified below.

Electronic technical data submittals shall be made using IBackup, a Web-based file transfer service. If Contractor does not already have IBackup transmittal capability, information is available at <http://www.ibackup.com/>. (The Uniform Resource Locator [URL] to be used for electronic file submittals will be made available upon Contract award.)

Electronic technical data submittals shall be made using IBackup, a Web-based file transfer service. Instructions for uploading submittals to IBackup will be provided upon award.

Upon upload of the submittals, an email notification should be sent to the following individuals:

Gene Bergt – BergtGE@bv.com

Jamila Akrayi – akrajr@jea.com

The following subject line shall be included on all email notifications:

196116.70.0100 YYMMDD JEA GEC Fuel Oil/Demineralized Water Storage Tank Addition Project –
Transmittal No. XX – DISCIPLINE

YYMMDD = Date of Transmittal in the listed format

Transmittal No. XX = Unique Sequential Transmittal Number
DISCIPLINE = Electrical, Mechanical, Civil/Structural or Architecture

The following number of prints shall be submitted unless otherwise indicated in the Schedule of Submittals:

Submittal Description	Copies Required	
	Engineer	Owner
Design Data	1 Electronic Copy	1 Electronic Copy and 1 Full Size Print
Test and Inspection Data	1 Electronic Copy	1 Electronic Copy and 1 Full Size Print
Drawings	1 Electronic Copy	1 Electronic Copy, 1 ANSI C Size Print

Q500.2 Compliance Reports

Reports shall be submitted that record the tests and/or calculations required in the specification technical sections. Reports shall be submitted for each piece of equipment or each plant system. Specified drawings shall be submitted with the compliance reports.

Q500.3 Motor and Electric Actuator Information

If required by the Specifications, Motor and Electric Actuator Information shall be submitted in accordance with Supplemental Q502.

Q500.4 Drawings

Drawings shall be in sufficient detail to indicate the kind, size, arrangement, component weight, breakdown for shipment, and operation of component materials and devices; the external connections, anchorages, and supports required; the dimensions needed for installation and correlation with other materials and equipment; and the information specifically requested in the Schedule of Submittals.

Contractor shall fully complete and certify drawings for compliance with the Contract requirements. Drawings shall have title block entries that clearly indicate the drawing is certified.

Each submitted drawing shall be project unique and shall be clearly marked with the name of the project, unit designation, Owner's Contract title, Owner's Contract file number, project equipment or structure nomenclature, component identification numbers, and Owner's name. Equipment, instrumentation, and other components requiring Owner-assigned identification tag numbers shall be clearly identified on the drawings. If standard drawings are submitted, the applicable equipment and devices furnished for the project shall be clearly marked.

Transmittal letters shall identify which Schedule of Submittals item (by item number) is satisfied by each drawing or group of drawings. The transmittal letter shall include the manufacturer's drawing number, revision number, and title for each drawing attached. Each drawing title shall be unique and shall be descriptive of the specific drawing content. Transmittal letters for resubmitted drawings shall include the Engineer's drawing numbers.

Catalog pages are not acceptable, except as drawings for standard nonengineered products and when the catalog pages provide all dimensional data, all external termination data, and mounting data. The catalog page shall be submitted with a typed cover page clearly indicating the name of the project, unit

designation, specification title, specification number, component identification numbers, model number, Contractor's drawing number, and Owner's name.

Drawings shall be submitted with all numerical values in English units.

Q500.4.1 Drawing Submittal

A standard drawing submittal template form and transmittal letter are included at the end of this section. Contractor shall use this form for all submittals. (An electronic copy of this form will be made available upon Contract award.)

Drawings shall be submitted electronically in Tagged Image File Format (TIFF) - Group 4 or Adobe Portable Document Format (PDF). AutoCAD or MicroStation format files are not acceptable.

If hard copies are required for submittal, the separately submitted hard copy drawing prints shall be black line on white background. Blue line on white background or color prints are not acceptable. All drawings shall be suitable for electronic imaging and shall have the maximum contrast. Print size shall not exceed 34 inches by 44 inches. Drawings shall be folded to 8-1/2 inches by 11 inches. Drawings shall be collated in sets.

Q500.4.2 Drawing Processing

Contractor's engineering schedule shall allow a minimum of three (3) weeks for mailing, processing, and review of drawings and data by Owner Engineer.

Unless this Contract indicates that a drawing or engineering data submittal by Contractor is to be for Engineer's information only, Engineer, upon receipt of submittals, shall review and return same to Contractor, marked "No Exceptions Noted," "Exceptions Noted," "Received for Distribution," "Returned for Corrections," "Release for Record," "Void," or "Superseded." The timing of Contractor's submittals and Engineer's review shall be in accordance with the Completion Dates for same as set forth in the Contract. The submittal of any drawing or other submittal document by Contractor to Engineer under this Contract will be certification by Contractor that the information set forth therein is accurate in all material respects.

Q500.4.2.1 No Exceptions Noted (NE) or Received for Distribution (RD). Upon receipt of a submittal marked "No Exceptions Noted" or "Received for Distribution," Contractor may proceed with its Work to the extent of and in accordance with the submittal. Contractor shall not resubmit unless the drawing or document is revised, in which case it shall be resubmitted as a new document revision in accordance with Q500.4.2.7.

Q500.4.2.2 Exceptions Noted (EN). Upon receipt of a submittal marked "Exceptions Noted" and if Contractor concurs with Engineer's comments, Contractor shall incorporate same and may proceed with its Work to the extent of and in accordance with the annotated submittal. Contractor shall submit to Engineer within fourteen calendar days a revision to the original submittal in which Engineer's comments have been incorporated. If Contractor determines that it cannot incorporate Engineer's comments without prejudice to Contractor's warranty or other obligations under this Contract, Contractor shall so advise Engineer in writing within seven calendar days of its receipt of Engineer's comments, stating the reasons therefore. Contractor may proceed with its Work to the extent of and in accordance with the annotated submittal only upon Engineer and Contractor resolving Engineer's comments.

Q500.4.2.3 Returned for Corrections (RC). Upon receipt of a submittal marked "Returned for Corrections," Contractor shall immediately take all necessary action to revise its submittal in accordance with Engineer's comments, the Specification, and the Drawings, and shall resubmit to Engineer for review the corrected original submittal, voiding previous information and adding new documents if required. In no event shall Contractor proceed with the affected Work until its revised submittals have been returned to Contractor marked "No Exceptions Noted" or "Exceptions Noted" by Engineer.

Q500.4.2.4 Release for Record (RR). Receipt of a submittal marked "Release for Record" indicates that there are no specific objections to the document. Work may proceed. Certain project information required by the Engineer's document management system may have been added electronically to the drawing and provided to Contractor for the record. Contractor shall not resubmit the drawing or document unless revisions to the design are required. If revisions are required, Contractor shall incorporate Engineer's information and resubmit as a new revision. Engineer's project-specific information shall be added if future revisions and submittals are made.

Q500.4.2.5 Void (VO) or Superseded (SS). Receipt of a submittal marked "Void" or "Superseded" does not require any action by Contractor. "Void" indicates that the submittal is no longer applicable to the project and is not being replaced by other drawings or data. "Superseded" indicates that different drawings or data have replaced the previously submitted drawings and data; this status does not pertain to revisions of the same drawings and data.

Q500.4.2.6 Hold (HO). A submittal may be given a status of "Hold" by the Engineer, or the Contractor may have "Holds" on the submitted drawing.

For a Hold status designated by the Engineer, the Contractor shall not proceed with the work that is designated on "Hold" except as specifically directed by the Engineer. Additional information required for the Contractor to release the "Hold" will be transmitted from the Engineer later.

The Contractor shall provide information to the Engineer about the cause for any "Holds" designated on the drawing and immediately take all action necessary to resolve the "Holds". The Contractor shall resubmit the drawing for review once the "Holds" are removed from the drawing and should make all efforts to not submit drawings to the Engineer until drawing review comments have been received back from the Engineer.

Q500.4.2.7 Resubmittals. If during or subsequent to the completion of the submittal process, Contractor makes further changes to the equipment and materials shown on submittals that have been reviewed by Engineer, the changes shall be clearly marked on the submittal by Contractor and the submittal process shall be repeated. If changes are made by Contractor after delivery to the Jobsite, as-built drawings indicating the changes shall be prepared by Contractor and submitted to Engineer for review. Any resubmittal of information shall clearly identify the revisions by footnote or by a form of back-circle, with revision block update, as appropriate.

Q500.4.2.8 Engineer's Review. Engineer's review of drawings and other submittals will cover only general conformity of the data to the Specifications and Drawings, external connections, interfaces with equipment and materials furnished under separate specifications, and dimensions that affect plant arrangements. Engineer's review does not include a thorough review of all dimensions, quantities, and details of the equipment, material, device, or item indicated or the accuracy of the information submitted. Review and comment by Engineer of Contractor's Drawings or other submittals shall not relieve Contractor of its sole responsibility to meet the Completion Dates requirement of this Contract and to supply Goods that conform to the requirements of this Contract.

Q500.4.2.9 File Returns to Contractor. The IBackup web service will be used by Engineer to return TIFF files to Contractor.

A copy of the manifest will be returned to Contractor indicating drawings statused as NE (No Exceptions Noted).

Each packet of drawings returned to Contractor will include a manifest generated by Engineer. The manifest will include a list of drawings transmitted, manufacturer's drawing numbers, Engineer's assigned drawing numbers, Engineer's drawing titles, and the status of the drawings.

Files returned to Contractor will be in TIFF Group 4 format unless another format is agreed upon by Engineer and Contractor.

Q500.5 Wiring Diagrams

If required by the Specifications, Wiring Diagrams shall be submitted in accordance with Supplemental Q502.

Q500.6 Instruction Manuals

If required by the Specifications, Instruction Manuals shall be submitted in accordance with Supplemental Q501.

SAMPLE LETTER OF TRANSMITTAL

To: Black & Veatch Corporation
12740 Gran Bay Parkway W, Ste 2140
Jacksonville, FL 32258

Attention: Mr. Gene Bergt

From: (Contractor Name)
(Street Address)
(City, State, Zip)
(Contact Name)
(Contact Phone No.)
(Email Address)

Project Name: JEA GEC Fuel Oil/Demineralized Water Storage Tank Addition

Black & Veatch Project Number: 196116.70.0100

Date: (fill-in)

Contractor Transmittal No. (fill-in)
(other Contractor-specific information)

Submittal Item No	Mfr Dwg #	Rev	# of Sheets	Title	Elec File Name	Resubmittal (Y/N) ?

Q501 Instruction Manuals

(Source: 27Apr10 - Revised by Project: 02Jun11)

This section, in conjunction with Section Q500 stipulates the requirements for Instruction Manuals that Contractor shall submit for design information and review. Document submittal procedures shall be in accordance with the requirements of this Contract, Section Q500, and the following.

Q501.1 Submittal Requirements

Hard copies shall be submitted for the documents listed below. The following number of copies shall be submitted unless otherwise indicated in the Schedule of Submittals:

Submittal Description	Copies Required
Proof Copies	1 Electronic Copy (Table of Contents only)
Final Copies	3 Electronic Copies on CD, 3 Hard Copies

Q501.2 Instruction Manuals

Contractor shall furnish proof and final instruction manuals for the unloading, storage, installation, operation, and maintenance of the equipment. The manuals shall be delivered as specified in the Schedule of Submittals.

Manuals shall include the following information specific to the furnished equipment. The documents or drawings submitted within the Instruction Manual shall be consistent with the documents or drawings previously submitted for Owner's review. Documents or drawings which were previously submitted for review and are included within the Instruction Manual shall be identical, with the same revision number. If these documents or drawings were revised due to design revisions subsequent to issuance of the Instruction Manuals, the document or drawing shall be resubmitted in accordance with Article Q500.4.2.7 in Supplemental Q500 so the Owner can provide updated drawings to the holders of the Instruction Manuals.

Table of contents and index tabs. (If multiple volumes are required, a table of contents listing materials included in each volume shall be supplied for each volume.)

Specifications and test data specified in the technical specifications.

Description of the equipment, including illustrations showing elevations, cross section, and all details of the equipment with all parts named, numbered, and identified with Owner's tag numbers. When multiple model numbers are shown on the drawings, the equipment supplied for the project shall be clearly identified.

Complete and detailed operating instructions, including safety precautions, philosophy of operation and, where applicable, process optimization techniques.

Detailed minor and major maintenance instructions, including description, use of special tools furnished, and preventive maintenance schedule.

Instructions for receiving, inspection, storage, and handling of equipment prior to installation.

Installation instructions.

Inspection procedures.

Troubleshooting guide.

All fluid systems schematics and piping diagrams.

Control logic diagrams, as applicable.

Electrical wiring diagrams, as applicable.

Calibration Data Sheet for each adjustable instrument included in the scope of supply.

Control Panel Arrangements, as applicable.

Contractor and sub-supplier operating and maintenance manuals.

Illustrated parts breakdown.

Assembly drawings.

Parts lists.

List of acceptable lubricants.

Nameplate information and shop order numbers for each item of equipment and associated component parts thereof.

List of recommended spare parts.

List of maintenance tools furnished with the equipment.

The above listed requirements are the minimum requirements; however, requirements that are clearly not applicable to the equipment may be deleted with Owner's approval. Additional information that is necessary for proper operation and care of the equipment shall also be included..

Q501.2.1 Binding

Each copy of the manuals shall be assembled and bound in three-ring or post binders designed for rough usage. Light-duty binders will not be acceptable.

Front covers and backbones of the manuals shall be permanently marked with lettering per the Typical Instruction Book Cover attached at the end of this section.

TYPICAL INSTRUCTION BOOK COVER

<p>NAME OF EQUIPMENT</p> <p>JEA</p> <p>GREENLAND ENERGY CENTER</p> <p>CONTRACT NUMBER**</p> <p>VOLUME NUMBER*</p>	<p>JEA</p> <p>GREENLAND ENERGY CENTER</p> <p>INSTRUCTION BOOK FOR NAME OF EQUIPMENT VOLUME NUMBER*</p> <p>CONTRACT NUMBER**</p> <p>MANUFACTURER'S NAME MANUFACTURER'S ADDRESS</p> <p>BLACK & VEATCH JACKSONVILLE, FL</p>	<p>36</p> <p>24 24</p> <p>36 36 36 36</p> <p>24</p> <p>24 24</p> <p>14 14</p>
(Backbone)	(Cover)	

NOTES:

1. All lettering shall be a block style font such as Arial.
2. All backbone lettering shall be 14 point.
3. Cover lettering shall be point sizes indicated in column to right of cover illustration.
4. *Volume number required only if instructions are contained in more than one volume.
5. **Owner assigned Contract number.

Q502 Electrical Data

(Source: 08Apr09 - Revised by Project: 22July11)

This section, in conjunction with Section Q500 and the Schedule of Submittals included in the Supplemental Terms and Conditions of this Contract, stipulates the requirements for Electrical Data that Contractor shall submit for design information and review. Document submittal procedures shall be in accordance with the requirements of this Contract, Section Q500, and the following.

Q502.1 Submittal Requirements

Electronic copies shall be submitted to the address indicated for Technical Documents in the Supplementary Terms and Conditions of this Contract for the documents listed below. The following number of copies shall be submitted unless otherwise indicated in the Schedule of Submittals:

Submittal Description	Copies Required
Refer to Schedule of Submittals	Electronic
Wiring diagrams	Electronic

Q502.2 Not Used

Q502.3 Wiring Diagrams

Connection and interconnection wiring diagrams furnished by Contractor shall be drawn with all devices indicated in their relative physical locations and shall accurately show the equipment and terminals arranged as they would appear to a person wiring the equipment. When accepted by Engineer, termination schedules identifying field terminations may be substituted for wiring diagrams for connections external to equipment.

When the equipment furnished by the Contractor is split for shipment and provided with terminal blocks and wiring required to interconnect the shipping sections in the field, the wiring diagrams from the Contractor shall clearly identify that the wiring across the shipping splits needs to be field installed.

Where interconnecting wiring from different items of equipment or sectional wiring diagrams of the same item of equipment appear on different wiring diagram sheets, all interconnections shall be clearly identified. Where sectional wiring diagrams are required for a single item of equipment, such as a relay panel or control panel, the section of the panel that is represented by each individual wiring diagram sheet shall be keyed on that sheet in a manner acceptable to Engineer.

Information indicated on Contractor's drawings shall include wiring and terminal numbers of the individual panel items as they actually will appear in the panel, set points, contact arrangements of switches and relays (state of device and device contacts shall be clearly indicated), and internal wiring of relays and instruments. Spare terminals and all unused contacts of the individual panel items shall be shown on the drawings.

Elementary diagrams shall be cross-referenced to terminal markings on the connection and interconnection diagrams, but do not need to indicate complete details of circuits external to the panels, unless required by Engineer. Each item of panel mounted equipment indicated on the diagrams shall be identified by item number and name.

Q502.3.1 As-Built Drawings

As-built prints of each final electrical wiring and elementary diagram for equipment shall be furnished in accordance with Article Q500.4.2.7. An electronic copy in AutoCAD format of each drawing shall be submitted to Engineer.

02220 - Earthwork

02220.1 General

02220.1.1 Scope of Work

Scope of Work shall include completing earthwork and shall include other services as specified under these technical specifications.

02220.1.2 Not Used

02220.1.3 Performance and Design Requirements

Performance and design requirements for earthwork are indicated in Article 02220.3.

02220.1.4 Codes and Standards

Work performed under these specifications shall be done in accordance with the following codes and standards. Unless otherwise specified, the applicable governing edition and addenda to be used for all references to codes or standards specified herein shall be interpreted to be the jurisdictionally approved edition and addenda. If a code or standard is not jurisdictionally mandated, then the current edition and addenda in effect at the date of this document shall apply. These references shall govern the work except where they conflict with the Owner's specifications. In case of conflict, the latter shall govern to the extent of such difference:

Work	In Accordance With
Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)	ASTM D2487
Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)	ASTM D2488

02220.1.5 Materials

The following materials shall be used:

General	
Component	Material
Standard Specification for Road and Bridge Construction	Florida Department of Transportation (FDOT) Standard Specifications for Road and Bridge Construction 2007

02220.1.6 Approved Manufacturers of Components

For the following components, only the listed manufacturers are recognized as maintaining the level of quality of workmanship required by these specifications. If the Contractor wants to propose a non-listed manufacturer that is considered to provide an equivalent level of quality, this manufacturer must be identified and supporting testimony provided. Acceptance of the manufacturer as a substitute is at the discretion of the Owner:

Component	Manufacturer
Nuclear Surface Moisture-Density Gauge	Troxler Model 3430, 3440, 3450, 3451
Nuclear Surface Moisture-Density Gauge	Campbell Pacific Nuclear (CPN) Model MC-3 and MC-1

02220.1.7 Test Requirements

The following testing shall be conducted in accordance with the specified source. Material, compaction, and testing requirements are found in Table 1.

This testing is to be considered part of the defined Scope of Work, and all associated costs are the responsibility of the Contractor:

Tests	In Accordance With	Conducted By
Standard Test Method for Particle Size Analysis of Soils	ASTM D422	Contractor
Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft ³ (600 kn-m/m ³))	ASTM D698 (Standard Proctor)	Contractor
Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method	ASTM D1556	Contractor
Standard Test Methods for Laboratory Compaction characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft ³ (2,700 kn-m/m ³))	ASTM D1557 (Modified Proctor)	Contractor
Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method	ASTM D2167	Contractor
Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)	ASTM D2922	Contractor
Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)	ASTM D3017	Contractor
Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table	ASTM D4253	Contractor

Tests	In Accordance With	Conducted By
Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density	ASTM D4254	Contractor
Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils	ASTM D4318	Contractor
Standard Test Method for Field Water Content	ASTM D3017	Contractor
Florida Method of Test for Limerock Bearing Ratio	FM 5-515	Contractor

02220.1.8 Technical Attachments

Technical attachments relevant to the work under this section are listed in Section 01100.5.

02220.1.9 Not Used

02220.2 Not Used

02220.3 Execution

02220.3.1 General

This article covers general earthwork; removal and disposal of debris; excavation; the handling, storage, transportation, and disposal of excavated material; sheeting, shoring, and protection work; preparation of subgrades; dewatering; protection of adjacent construction; backfill; construction of fills and embankments; surfacing and grading; and other appurtenant work.

All excavations, sheeting, shoring, and temporary excavation support shall be performed in accordance with OSHA 29CFR Part 1926, Subpart P, "Excavations."

02220.3.2 Sheeting and Shoring

The stability of previously constructed structures and facilities shall not be impaired or endangered by excavation work. Previously constructed structures and facilities include both structures and facilities existing when this construction began and structures and facilities already provided under these specifications.

Adequate sheeting and shoring shall be provided to protect and maintain the stability of previously constructed structures and facilities and the sides of excavations until they are backfilled. Sheeting, bracing, and shoring shall be designed and built to withstand all loads and restrain all settlement caused by earth movement or pressure, and shall maintain the shape of the excavation.

02220.3.3 Removal of Water

Adequate dewatering equipment shall be provided to remove and dispose of all surface and ground water entering excavations and other parts of the work. Each excavation shall be kept dry. Control of ground water shall be accomplished in a manner that will preserve the strength of the foundation soils, will not cause instability of the excavation slopes, and will not result in damage to existing structures. Where necessary to these purposes, the water level shall be lowered in advance of excavation, utilizing wells, well points, or similar methods. The water level as measured in piezometers shall be maintained continuously about 1 foot below the prevailing excavation level, or it shall be lowered to within about

1 foot of impermeable strata. Open pumping with sumps and ditches, if it results in boils, loss of fines, softening of the ground, or instability of slopes, will not be permitted. Wells and well points shall be installed with suitable screens and filters so that continuous pumping of fines does not occur. Dewatering shall continue until the construction is no longer affected by ground or surface water. Surface water may be pumped to adjacent catch basins and the Stormwater Pond. The turbidity of the discharge to the catch basins and Stormwater Pond shall be less than 29 NTU. If samples indicate the turbidity is greater than 29 NTU, it will be the responsibility of the Contractor to employ means to lower the turbidity of the discharge below 29 NTU. Groundwater Dewatering discharge shall be routed to a local percolation basin constructed by the Contractor.

Surface water shall be diverted to the extent possible to prevent entrance into excavations.

Pipe or conduit used for drainage purposes shall be kept clean and free of sediment. Temporary drainage piping that is not a part of the permanent construction shall be removed at the completion of the work.

When the work is completed, all parts of the permanent plant drainage system used for water disposal that have been damaged by dewatering operations shall be repaired. Dewatering work shall not overload the plant drainage system. The Owner shall determine the appropriate locations of the dewatering basins based on permit requirements, discussions with the Engineer, and plant requirements.

Header systems may be laid on top of the ground provided they do not obstruct plant operations, construction activity, or traffic. Groundwater systems shall operate continuously, if necessary, to maintain the specified water level.

Proposed dewatering systems shall be submitted to the Owner for review.

02220.3.4 Blasting

Blasting or other use of explosives for excavation will not be permitted.

All rock which cannot be handled, crushed, processed, and compacted as earth shall be kept separate from other excavated materials and shall not be mixed with backfill or embankment materials except as specified or directed.

02220.3.5 Not Used

02220.3.6 Freezing Weather Restrictions

Backfill and fill shall not be placed during freezing weather unless acceptable to the Owner. Earth material shall not be placed on frozen surfaces, and frozen materials, snow, or ice shall not be placed in any fill or backfill.

02220.3.7 Preservation of Trees

Trees shall be preserved and protected as much as possible. Unless specifically authorized by the Owner, trees shall be removed only from areas within the construction limits. Removal of additional trees may be permitted by the Owner when necessary for the effective execution of the work.

Trees left standing shall be protected from permanent damage. Construction equipment and vehicles shall be parked outside the dripline of trees designated to remain. Trimming of standing trees shall be as directed by the Owner.

02220.3.8 Maintenance of Traffic

Contractor shall conduct his work with as little interference as possible with the work of other contractors. Whenever it is necessary to cross, obstruct, or close roads, driveways, parking areas, and walks, the

Contractor shall provide and maintain suitable and safe bridges, detours, or other temporary expedients at his own expense. The Contractor shall submit a Maintenance of Traffic plan to the Owner for Review a minimum of 7 days ahead of planned closures.

02220.3.9 Unauthorized Excavation

Material excavated below the bottom of concrete structures to be supported on the subgrade shall be replaced with concrete placed monolithically with the concrete above. Rock fill or lean concrete may be used, if acceptable to the Owner. Material excavated below structures supported on piles or piers shall be replaced with crushed rock or gravel. The crushed rock or gravel shall be compacted to a density equal to or greater than the density of the adjacent undisturbed soil.

02220.3.10 Testing

Field and laboratory testing required to determine compliance with the compaction requirements shall be performed by an independent testing laboratory acceptable to the Owner and provided by the Contractor, as well as any labor necessary to support the testing process.

Field sampling and testing shall be performed by NICET Level II Construction Materials Testing technicians or a NICET Level II Construction Materials Testing technician employed by an independent testing company

Field samples shall be taken at locations selected by the Contractor. If, in the opinion of the Owner, additional field control tests are necessary such tests shall be made. Field density tests shall be taken so as to represent the average density over the depth of the layer.

The terms "maximum density" and "optimum moisture content" shall be as defined in ASTM D698 or ASTM D1557.

Relative density for compacted crushed rock materials shall be determined in accordance with ASTM D4253 and D4254. The term "relative density" shall be as defined in ASTM D4254.

A copy of each test result shall be furnished to the Owner. Testing requirements are provided in Table 1.

02220.3.11 Site Preparation

Subgrades for permanent construction, including subgrades for fills and embankments, shall be stripped of concrete, asphalt, conduit, pipes and demolition or construction debris.

All combustible and other wastes materials shall be removed from the construction areas. Disposal shall be as specified in Section 02231, Clearing and Grubbing.

Clean soil or gravel may be stockpiled for later reuse. Material containing particles (concrete or rock) greater than 4 inches in dimension shall be wasted at a location designated by Owner.

02220.3.12 Roadway Roadbeds

Roadway construction shall include excavation, subgrade preparation, and construction of fills and embankments. In excavated roadbed areas, overburden shall be removed and the subgrade shaped to line, grade, and cross section. Soft, organic, and other unacceptable material shall be removed from the subgrade and replaced. The replacement material shall meet the requirements of Article 02220.3.16, Structural Fill.

The subgrade shall be compacted in accordance with Table 1 and finished to a uniform surface to allow for proper drainage. The subgrade shall be finished to within 0.1 foot (0.03 m) of the elevation indicated on the drawings.

Ditches and drains along the subgrade shall be maintained for effective drainage. When ruts of 2 inches (51 mm) or more in depth are formed, the subgrade shall be reshaped and re-compacted.

Materials shall not be stored or stockpiled on subgrades.

02220.3.13 Fills and Embankments

Fills and embankments shall be constructed to lines and grades indicated on the drawings.

02220.3.13.1 Materials. To the maximum extent available, earth materials shall be obtained the existing on site spoil pile. The fill or embankment subgrade shall be scarified, leveled, and rolled. The surface materials of the subgrade shall be compacted and well bonded to the previous layers of fill. All material deposited in fills and embankments shall be earth only and shall be free from rocks or stones larger than allowed by Table 1, brush, stumps, logs, roots, debris, and organic or other objectionable materials. Material deposited in piles or windrows by excavating and hauling equipment shall be spread and leveled prior to compaction.

Fill and embankment material obtained from offsite sources shall be free of contamination. Free of contamination shall be defined as having a constituent concentration less than the lowest "Soil Cleanup Target Level" for that constituent listed in FDEP, Chapter 62-777 (8/5/1999), Contaminant Cleanup Target Levels, Table II - Soil Cleanup Target Levels. Inorganics, if above the levels in FDEP Chapter 62-777, must be within normal background levels for the site area."

Each layer shall be thoroughly compacted. If the material fails to meet the density specified, compaction methods shall be modified to attain the specified density. The failed layer shall be re-compacted until the layer meets the specification requirements.

02220.3.13.2 Subgrade Preparation. The subgrade shall be leveled and compacted in accordance with Table 1. The subgrade surface shall be well bonded to the previous layers of fill.

02220.3.13.3 Placement and Compaction. Fill and embankment materials shall be placed in approximately horizontal layers. Material deposited in piles or windrows shall be spread and leveled before compaction.

Water shall be added to meet the moisture content required in Table 1 and worked into each layer using harrow, disk, blade, or other acceptable equipment to provide uniform moisture content. If the material fails to meet the specified density in Table 1, compaction methods shall be altered.

02220.3.13.4 Borrow Areas. Material necessary to complete fills and embankments shall be excavated from borrow areas and hauled to the fill or embankment site. Borrow material will be available from a stock pile designated by the Owner on the site property..

02220.3.14 Structure Excavation

Excavation for structures shall be completed to the designated lines and elevations. Machine excavation shall be controlled to prevent undercutting the subgrade elevations indicated on the drawings.

Excavated materials that meet the specified requirements may be used for the fills, embankments, and backfills.

Vertical faces of excavations shall not be undercut to provide for extended footings.

02220.3.15 Structure Subgrades

Subgrades for structures shall be firm, dense, free from mud, thoroughly compacted to the specified density in Table 1, and sufficiently stable to remain firm and intact.

Structure subgrades that cannot achieve the required density shall be over-excavated and replaced with structural fill.

Subgrades that are otherwise solid, but become mucky on top due to construction operations, shall be stabilized by reinforcing them with one or more layers of crushed rock or gravel unless otherwise noted on the drawings.

The finished elevation of stabilized structure subgrades shall not be above the subgrade elevations indicated on the drawings.

02220.3.16 Structural Fill

Structural fill is placed beneath roads and structures. Structural fill shall be mechanically compacted. Structural fill requirements are provided in Table 1.

Particular care shall be taken to compact structural fill beneath pipes, drives, roads, or other surface construction. When a trench passes through structural fill, the fill shall be placed and compacted to at least 12 inches (305 mm) above the top of the pipe elevation before the trench is excavated.

02220.3.17 Structure Backfill

Backfill around and outside of structures shall be deposited in approximately horizontal layers. Backfill shall be mechanically compacted in accordance with Table 1. Compaction of structure backfill by rolling will be permitted provided the desired compaction is obtained and damage to the structure is prevented. Compaction of structure backfill by inundation with water will not be permitted.

Backfill material shall be composed of earth only and, to the extent possible, shall be void of wood, grass, roots, broken concrete, stones, trash, or other debris.

No tamped, rolled, or otherwise mechanically compacted backfill shall be deposited or compacted in water.

All backfill material shall consist of loose earth having a moisture content required in Table 1 to obtain the specified density (Table 1) of the compacted soil. Moisture content shall be distributed uniformly. Water added for correction of moisture content shall be distributed uniformly prior to compaction. Granular material shall be wet, not just damp, when compacted.

02220.3.18 Compacted Rock Fill

Compacted rock fill shall consist of crushed rock. Compaction shall be performed with vibrating mechanical compactors.

Crushed rock for compacted fill shall be handled and placed in a manner that will prevent segregation of sizes. The fill material shall have the moisture content specified in Table 1 to achieve compaction required in Table 1.

If concrete is to be placed on the compacted rock fill, the fill shall be finished with a thin layer of clean concrete sand to fill all voids and interstices to obtain the required subgrade elevation.

02220.3.19 Compacted Sand Fill

Compacted sand fill material shall consist of clean, natural sand.

Sand fills shall be placed on undisturbed subgrade. Sand shall be compacted using mechanical vibrators. Compaction and moisture content shall be in accordance with Table 1.

02220.3.20 Drainage Fills

Sand drainage fills and drainage filter material shall be as indicated on the drawings. Unwashed material is unacceptable.

Sand drainage fill and drainage filter material shall be compacted with a vibrating compactor. Compaction and moisture content shall be in accordance with Table 1.

02220.3.21 Not Used

02220.3.22 Maintenance and Restoration of Fills, Embankments, and Backfills

Fills, embankments, and backfills that settle or erode before Acceptance of the work, and pavement, structures, and other facilities damaged by such settlement or erosion shall be repaired. The settled or eroded areas shall be filled, compacted, and graded to conform to the elevation indicated on the drawings or to the elevation of the adjacent ground surface. Damaged facilities shall be repaired in a manner acceptable to the Owner.

Earth slopes of the roads and railroads constructed under these specifications shall be maintained to the lines and grades indicated on the drawings until Acceptance of the work.

02220.3.23 Final Grading

After all construction work has been completed, all ground surface areas disturbed by construction activities shall be graded. The grading shall be finished to the contours and elevations indicated on the drawings or, if not indicated, to the matching contours and elevations of the original, undisturbed ground surface. The final grading shall provide smooth uniform surfaces and effective drainage of the ground areas.

02220.3.24 Disposal of Materials

Surplus earth and materials not suitable for the work shall be spoiled on the site in a manner and location designated by the Owner. Offsite disposal may be used, if allowed by the Owner. Disposal shall be in accordance with all federal, state, and local requirements.

Table 1
Materials, Compaction, and Testing Requirements

Material	Plasticity Requirements	Gradation Requirements	Maximum Density	Maximum Density Test Frequency	Required Field Density	Field Density Test	Field Density Test Frequency	Required Field Water Content	Field Water Content Test	Required Lift Thickness	Remarks
Fills and embankments	LL < 40 PI < 15	6 inch max; 3 inch max in upper 18 inches	ASTM D1557, Method C	3 initial tests, further tests as directed	95% Max. Dry Density	ASTM D2922 (10% of tests to be ASTM D1556)	One test per 500 cy, or as required	-2% to +2% of optimum water content	ASTM D3017 (10% of tests to be ASTM D1556)	8 in. uncompacted	Top 1 inch of each lift shall be scarified to promote bonding between lifts.
Structure subgrade	LL < 40 PI < 15	3 inch maximum;	ASTM D1557, Method C	1 initial test; further tests as directed	95% Max. Dry Density	ASTM D2922 (10% of tests to be ASTM D1556)	One test per 200 sy, or as required. Min one per foundation for foundations over 10 sy	-2% to +2% of optimum water content	ASTM D3017 (10% of tests to be ASTM D1556)	8 in. depth	-
Structural fill (Fills beneath structures)	LL < 40 PI < 15	3 inch maximum;	ASTM D1557, Method C	3 initial tests, further tests as directed	95% Max. Dry Density	ASTM D2922 (10% of tests to be ASTM D1556)	One test per 200 cy, or as required. Min one per foundation for foundations over 10 sy	-2% to +2% of optimum water content	ASTM D3017 (10% of tests to be ASTM D1556)	8 in. uncompacted	-

Table 1
Materials, Compaction, and Testing Requirements

Material	Plasticity Requirements	Gradation Requirements	Maximum Density	Maximum Density Test Frequency	Required Field Density	Field Density Test	Field Density Test Frequency	Required Field Water Content	Field Water Content Test	Required Lift Thickness	Remarks
Structure backfill	Non-swelling; LL < 50; Any cohesive content must be CL or ML.	3 inch max ≤85 percent minus No. 200	ASTM D1557, Method C	3 initial tests; further tests as directed	95% Max. Dry Density	ASTM D2922 (10% of tests to be ASTM D1556)	One test per 200 cy, or as required	-2% to +2% of optimum water content	ASTM D3017 (10% of tests to be ASTM D1556)	8 in. uncompacted	Compaction by inundation with water will not be permitted.
Compacted rock fill	Non-plastic	1-1/2 in. (38 mm) max. to crusher fines	ASTM D4253 and D4254	3 initial tests; further tests as directed	85% Relative Density	ASTM D2922 (10% of tests to be ASTM D1556)	One test per 200 cy, or as required	As required to achieve field density	ASTM D3017 (10% of tests to be ASTM D1556)	8 in. uncompacted	-
Compacted sand fill	Non-plastic	≥75% minus No. 4; ≤10% minus No. 200;	ASTM D1557, Method C	3 initial tests; further tests as directed	92% Max. Dry Density	ASTM D2922 (10% of tests to be ASTM D1556)	One test per 200 cy, or as required	-2% to +2% of optimum water content	ASTM D3017 (10% of tests to be ASTM D1556)	8 in. uncompacted	-

Table 1
Materials, Compaction, and Testing Requirements

Material	Plasticity Requirements	Gradation Requirements	Maximum Density	Maximum Density Test Frequency	Required Field Density	Field Density Test	Field Density Test Frequency	Required Field Water Content	Field Water Content Test	Required Lift Thickness	Remarks
ASTM C33 = Standard Specification for Concrete Aggregates. ASTM D698 = Standard Test Methods for Laboratory Compaction Characteristics of Soil using Standard Effort (12,400 ft-lb/ft³). ASTM D1556 = Standard Test Method for Density and Unit Weight of Soil in Place by the Sand Cone Method. ASTM D1557 = Standard Test Methods for Laboratory Compaction Characteristics of Soil using Modified Effort (56,000 ft-lb/ft³) ASTM D2167 = Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber-Balloon Method. ASTM D2922 = Standard Test Method for Density of Soil and Soil Aggregate in Place by Nuclear Methods (Shallow Depth). ASTM D3017 = Standard Test Method for Water Content for Soil and Rock in place by Nuclear Methods (Shallow Depth). ASTM D4253 = Standard Test Methods for Maximum Index Density and Unit Weight of Soils using a Vibratory Table. ASTM D4254 = Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.											

02315 - Trenching

02315.1 General

02315.1.1 Scope of Work

Scope of Work shall include completing trenching and shall include other services as specified under these technical specifications.

02315.1.2 Not Used

02315.1.3 Performance and Design Requirements

Performance and design requirements for trenching are indicated in Article 02315.3.

02315.1.4 Codes and Standards

Work performed under these specifications shall be done in accordance with the following codes and standards. Unless otherwise specified, the applicable governing edition and addenda to be used for all references to codes or standards specified herein shall be interpreted to be the jurisdictionally approved edition and addenda. If a code or standard is not jurisdictionally mandated, then the current edition and addenda in effect at the date of this document shall apply. These references shall govern the work except where they conflict with the Owner's specifications. In case of conflict, the latter shall govern to the extent of such difference:

Work	In Accordance With
Standard Specification for Aggregates or "Standard Specifications for Road and Bridge Construction"	ASTM C33 or Florida Department of Transportation (FDOT)
Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)	ASTM D2487
Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)	ASTM D2488

02315.1.5 Materials

The following materials shall be used:

General	
Component	Material
Refer to Table 1 at the end of this section.	

02315.1.6 Not Used

02315.1.7 Test Requirements

The following testing shall be conducted in accordance with the specified source.

This testing is to be considered part of the defined Scope of Work, and all associated costs are the responsibility of the Contractor unless specifically identified as Owner-conducted. If identified as Owner-

conducted, costs for the initial test will be the responsibility of the Owner. However, the Contractor is responsible for all costs associated with correcting deficiencies and retesting in the event of a test failure:

Tests	In Accordance With	Conducted By
Refer to Table 1 at the end of this section.		
Test Methods for Moisture Density Relations of Soils and Soil Aggregate Mixtures Using 5.5 lb Rammer and 12 in. Drop	ASTM D698 (Standard Proctor)	
Test Methods for Moisture Density Relations of Soils and Soil Aggregate Mixtures Using 10 lb Rammer and 18 in. Drop	ASTM D1557 (Modified Proctor)	Contractor
Standard Test Methods for Maximum Index Density Using a Vibratory Table	ASTM D4253	Contractor
Standard Test Methods for Minimum Index Density of Soils and Calculation of Relative Density	ASTM D4254	Contractor
Soil In-Place Density by Sand Cone Method	ASTM D1556	Contractor
Soil In-Place Density by Nuclear Density Meter	ASTM D2922	Contractor
Soil In-Place Density by Rubber Balloon Method	ASTM D2167	Contractor
Standard Test Method for Particle Size Analysis of Soils	ASTM D422	Contractor
Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils	ASTM D4318	Contractor
Preparation and Testing of Controlled Low Strength Material Test Cylinders	ASTM D4832	Contractor

02315.1.8 Not Used

02315.1.9 Not Used

02315.2 Not Used

02315.3 Execution

02315.3.1 General

This article covers general trenching and includes preparation of the construction areas; removal and disposal of debris; trenching; the handling, storage, transportation, and disposal of excavated material; sheeting, shoring, and protection work; preparation of subgrades; dewatering; protection of adjacent construction; backfill; pipe embedment; construction of pipe bedding and trench backfill; surfacing and grading; and other appurtenant work.

All excavations, sheeting, shoring, and temporary excavation support shall be performed in accordance with OSHA 29 CFR Part 1926 Subpart P, "Excavations."

02315.3.2 Sheeting and Shoring

The stability of previously constructed structures and facilities shall not be impaired or endangered by excavation work. Previously constructed structures and facilities include both structures and facilities existing when this construction began and structures and facilities already provided under these specifications.

Adequate sheeting and shoring shall be provided to protect and maintain the stability of previously constructed structures and facilities and the sides of trenches until they are backfilled. Sheeting, bracing, and shoring shall be designed and built to withstand all loads and restrain all settlement caused by earth movement or pressure.

02315.3.3 Removal of Water

Adequate dewatering equipment shall be provided to remove and dispose of all surface and ground water entering excavations and other parts of the work. Each excavation shall be kept dry. Control of ground water shall be accomplished in a manner that will preserve the strength of the foundation soils, will not cause instability of the excavation slopes, and will not result in damage to existing structures. Where necessary to these purposes, the water level shall be lowered in advance of excavation, utilizing wells, well points, or similar methods. The water level as measured in piezometers shall be maintained continuously about 1 foot below the prevailing excavation level, or it shall be lowered to within about 1 foot of impermeable strata. Open pumping with sumps and ditches, if it results in boils, loss of fines, softening of the ground, or instability of slopes, will not be permitted. Wells and well points shall be installed with suitable screens and filters so that continuous pumping of fines does not occur. Dewatering shall continue until the construction is no longer affected by ground or surface water. Surface water may be pumped to adjacent catch basins and the Stormwater Pond. The turbidity of the discharge to the catch basins and Stormwater Pond shall be less than 29 NTU. If samples indicate the turbidity is greater than 29 NTU, it will be the responsibility of the Contractor to employ means to lower the turbidity of the discharge below 29 NTU. Groundwater Dewatering discharge shall be routed to a local percolation basin constructed by the Contractor.

Surface water shall be diverted to the extent possible to prevent entrance into excavations.

Pipe or conduit used for drainage purposes shall be kept clean and free of sediment. Temporary drainage piping that is not a part of the permanent construction shall be removed at the completion of the work.

When the work is completed, all parts of the permanent plant drainage system used for water disposal that have been damaged by dewatering operations shall be repaired. Dewatering work shall not overload the plant drainage system. The Owner shall determine the appropriate locations of the dewatering basins based on permit requirements, discussions with the Engineer, and plant requirements.

Header systems may be laid on top of the ground provided they do not obstruct plant operations, construction activity, or traffic. Groundwater systems shall operate continuously, if necessary, to maintain the specified water level.

Proposed dewatering systems shall be submitted to the Owner for review.

02315.3.4 Blasting

Blasting or other use of explosives for excavation will not be permitted.

02315.3.5 Classification of Excavated Materials

No classification of excavated materials will be made. Excavation work shall include the removal and handling of excavated materials regardless of the type, character, composition, or condition.

02315.3.6 Freezing Weather Restrictions

Embedment and backfill shall not be placed during freezing weather unless acceptable to the Engineer. Earth material shall not be placed on frozen surfaces, and frozen materials, snow, or ice shall not be placed in any embedment fill or backfill material.

02315.3.7 Preservation of Trees

Trees shall be preserved and protected as much as possible. Unless specifically authorized by the Site Construction Manager, trees shall be removed only from areas within the construction limits. Removal of additional trees may be permitted by the Site Construction Manager when necessary for the effective execution of the work.

Trees left standing shall be protected from permanent damage. Construction equipment and vehicles shall be parked outside the dripline of trees designated to remain. Trimming of standing trees shall be as directed by the Site Construction Manager.

02315.3.8 Maintenance of Traffic

The Contractor shall conduct his work with as little interference as possible with the work of other suppliers. Whenever it is necessary to cross, obstruct, or close roads, driveways, parking areas, and walks, the Contractor shall provide and maintain suitable and safe bridges, detours, or other temporary expedients at his own expense.

02315.3.9 Unauthorized Excavation

Material excavated below the bottom of concrete structures to be supported on the subgrade shall be replaced with concrete placed monolithically with the concrete above or with a lean concrete fill.

02315.3.10 Testing

Field density tests shall be taken so as to represent average density over the depth of the layer.

Laboratory testing shall be performed by an independent testing laboratory acceptable to the Owner. Field sampling shall be performed by NICET Level II technicians or an independent testing company.

Field samples shall be taken at locations selected by the Site QA Manager. If, in the opinion of the Site QA Manager, additional field control tests are necessary, such tests shall be made.

Maximum density for cohesionless and cohesive materials shall be determined in accordance with ASTM D698 or ASTM D1557. The terms "maximum density" and "optimum moisture content" shall be as defined in ASTM D698 or ASTM D1557.

A copy of each test result shall be furnished to the Owner on the day the test is performed.

02315.3.11 Trench Subgrades

Subgrades that are otherwise solid, but become mucky on top due to construction operations, shall be stabilized by reinforcing them with one or more layers of crushed rock or gravel.

Not more than 1/2 inch depth of mud or muck shall be allowed to remain on stabilized trench bottoms when pipe embedment material is placed.

02315.3.12 Pipe Trench Excavation

No more trench shall be opened in advance of pipe laying than is necessary to expedite the work.

Trench excavation shall be open cut from the surface except where boring is required.

02315.3.12.1 Alignment and Grade. The alignment and grade or elevation of each pipeline shall be fixed and determined by means of batter boards and offset stakes, laser beam equipment, or surveying instruments, unless otherwise accepted.

02315.3.12.2 Limiting Trench Widths. Trench widths shall provide adequate working space and pipe clearance during installation. Trench width shall be kept to a minimum to allow installation and compaction around the piping.

Where necessary to reduce earth load on trench banks to prevent sliding and caving, banks may be cut back on slopes that shall not extend lower than 1 foot above the top of the pipe.

For single pipes, the maximum trench width measured at the bottom of the pipe shall be the pipe outside diameter plus 24 inches for pipes 48 inches outside diameter and smaller. For single pipes larger than 48 inches outside diameter, the maximum width measured at the bottom of the pipe shall be the pipe outside diameter plus 48 inches.

For multiple pipes in a common trench, the maximum trench width shall be based on the outside diameter of the outside pipes. The maximum clear distance between the trench wall and the adjacent pipe shall be 24 inches for 48 inch and smaller pipes and shall be 48 inches for pipes larger than 48 inches.

02315.3.12.3 Unauthorized Trench Widths. If the width of the lower portion of the excavated trench exceeds the maximum specified, corrective measures shall be taken. These may include the use of a stronger pipe, special pipe embedment, or concrete encasement, as required by the loading conditions. The corrective measures shall be submitted to the Engineer for engineering review.

02315.3.12.4 Mechanical Excavation. Mechanical equipment shall not be used in locations where operation would cause damage to trees, buildings, culverts, or other existing property, utilities, or structures above or below ground. Hand excavating methods shall be used in these locations.

02315.3.12.5 Trench Depth. Pipe trenches shall be excavated to the depth required for the installation of embedment material or concrete for encasement below the underside of the pipe.

02315.3.12.6 Bell Holes. Bell holes shall provide adequate clearance for tools and methods used to install the pipe. No part of any bell or coupling shall be in contact with the trench bottom, walls, or embedment when the pipe is jointed.

02315.3.13 Pipe Embedment

Embedment materials and placement shall conform to the requirements of these specifications and to the drawing included as an attachment to this specification.

02315.3.13.1 Embedment Classes. Class B bedding shall be used for all pipe installation per the attached drawing DS-0053 Pipe embedment classes shall be as indicated on the attached drawing and the following requirements:

02315.3.13.2 Placement and Compaction. Embedment material shall be spread on the trench bottom and the surface graded to provide a uniform and continuous support beneath the pipe at all points between bell holes or pipe joints. The material shall be compacted with vibrating platform type compactors. Compactive effort and moisture content shall be adjusted to provide a firm but slightly yielding support for the pipe.

After each pipe has been placed in final position on the bedding material and shoved home, sufficient pipe embedment material shall be deposited and compacted under and around each side of the pipe and back of the bell or end to hold the pipe in proper position and alignment during subsequent pipe jointing and embedment operations.

Embedment material shall be deposited and compacted uniformly and simultaneously on sides of the pipe to prevent lateral displacement. Each layer shall be uniformly compacted.

Vibrating compactors shall be used to compact sand, crushed rock, and crushed gravel. Pipe coatings shall not be damaged during placement and compaction.

02315.3.14 Trench Backfill

Trench backfill above the pipe embedment shall be compacted for the full depth of the trench above the embedment.

The top portion of backfill beneath established lawn areas shall be finished with at least 6 inches of topsoil similar to the topsoil in adjoining lawn areas.

Compacted backfill material shall be either job excavated material or material furnished by the Contractor from offsite sources. The method of compaction and the equipment used shall be appropriate for the material being compacted and shall not transmit damaging shocks to the pipe.

02315.3.15 Duct Bank Trenching

Trenches for duct banks shall be excavated to lines indicated on the drawings or at other locations acceptable to the Engineer and to within 1/2 inch of the depth required. Trenches shall be excavated to permit the duct bank to rest on undisturbed earth or rock. Where it is necessary to trench through backfill, the earth shall be well compacted before the duct bank is installed.

Trenches shall be wide enough to provide ample room for workmen engaged in handling and installing the ducts. Where it is necessary to reduce the earth load on trench banks to prevent sliding or caving, trench banks may be cut back on slopes.

02315.3.16 Pavement Removal and Replacement

Cuts in concrete and asphalt pavement shall be no larger than necessary to provide adequate working space for proper installation of pipe ducts structures and appurtenances. Cutting shall be started with a concrete saw and shall provide a clean groove at least 1-1/2 inches deep along each side of the trench.

Concrete and asphalt pavement shall be removed over trenches excavated for pipelines so that a shoulder not less than 6 inches in width is left between the cut edge of the pavement and the top edge of the trench. Trench width at the bottom shall not be greater than at the top. Trenches shall not be undercut. Pavement cuts shall be straight or accurately marked curved lines parallel to the centerline of the trench.

If the trench parallels the length of concrete walks and is all or partially under the walk, the entire walk shall be removed and replaced. Where the trench crosses drives, walks, curbs, or other surface construction, the surface shall be removed and replaced between existing joints or saw cuts.

Surfaces shall be replaced over backfilled trenches crossing surfaced areas. Replacement surfacing shall match the existing surfacing and be finished flush with the adjoining surfaces. Base material for surfacing shall match the thickness and density of the material excavated.

02315.3.17 Not used

02315.3.18 Maintenance and Restoration of Trench Backfills

Trench backfills that settle or erode before Acceptance of the work, and pavement, structures, and other facilities damaged by such settlement or erosion, shall be repaired. The settled or eroded areas shall be filled, compacted, and graded to conform to the elevation indicated on the drawings or to the elevation of the adjacent ground surface. Damaged facilities shall be repaired in a manner acceptable to the Engineer.

02315.3.19 Final Grading

After all construction work has been completed, all ground surface areas disturbed by construction activities shall be graded. The grading shall be finished to the contours and elevations indicated on the drawings or, if not indicated, to the matching contours and elevations of the original, undisturbed ground surface. The final grading shall provide smooth uniform surfaces and effective drainage of the ground areas.

02315.3.20 Disposal of Materials

Surplus earth and materials not suitable for the work shall be spoiled on the site in a manner and location designated by the Site Construction Manager. Disposal shall be in accordance with all federal, state, and local requirements.

Materials shall be deposited in the disposal areas and leveled and compacted in 12 inch maximum layers. Compaction shall be done by not less than three passes of a bulldozer.

Table 1
Materials, Compaction, and Testing Requirements

Material	Gradation Requirements	Plasticity Requirements	Maximum Density	Maximum Density Test Frequency	Required Field Density	Field Density Test	Frequency	Field Water Content	Field Water Content Test	Lift Thickness	Remarks
Trench subgrades	-	-	ASTM D1557, Method C	1 initial test; further tests as directed	95% Max. Dry Density	ASTM D2922 (10% of tests to be ASTM D1556)	One test per 100 feet of trench for each lift	-2% to +2% of optimum water content	ASTM D3017 (10% of tests to be ASTM D1556)	-	Trench subgrades shall be firm, dense, free from mud, thoroughly compacted, and sufficiently stable to remain firm and intact.
Crushed rock or crushed gravel embedment	Perform at least two gradation tests; pipe size 30" and smaller: at least 95% passing 1/2" sieve and not more than 5% passing No. 4 sieve	Nonplastic	ASTM D4253 and ASTM D4254	2 initial tests; further tests as directed	90% Relative Density	ASTM D2922 (10% of tests to be ASTM D1556)	One test per 100 feet of trench for each lift	-	-	8" max	
	Perform at least two gradation tests; pipe size 30" to 60": at least 95% passing 3/4" sieve and not more than 5% passing No. 4 sieve	Nonplastic	ASTM D4253 and ASTM D4254	2 initial tests, further tests as directed	90% Relative Density	ASTM D2922 (10% of tests to be ASTM D1556)	One test per 100 feet of trench for each lift	-	-	8" max	

Table 1
Materials, Compaction, and Testing Requirements

Material	Gradation Requirements	Plasticity Requirements	Maximum Density	Maximum Density Test Frequency	Required Field Density	Field Density Test	Frequency	Field Water Content	Field Water Content Test	Lift Thickness	Remarks
	Perform at least two gradation tests; pipe size over 60": at least 95% passing 1-1/2" sieve, 50% passing 3/4" sieve, and not more than 5% passing No. 4 sieve	Nonplastic	ASTM D4253 and ASTM D4254	2 initial tests; further tests as directed	90% Relative Density	ASTM D2922 (10% of tests to be ASTM D1556)	One test per 100 feet of trench for each lift	-	-	8" max	-
Sand embedment	Perform at least two gradation tests; at least 95% passing No. 4 sieve and not more than 5% passing No. 100 sieve	Nonplastic	ASTM D1557, Method C	2 initial tests; further tests as directed	95% Max. Dry Density	ASTM D2922 (10% of tests to be ASTM D1556)	One test per 100 feet of trench for each lift	-	-	8" max	Clean sand
Trench backfill	3" max particle size	-	ASTM D1557, Method C	2 initial tests; further tests as directed	95% Max Dry Density	ASTM D2922 (10% of tests to be ASTM D1556) or ASTM D1556 or ASTM D2167)	One test per 100 feet of trench for each lift	-2% to +2% of optimum water content	ASTM D3017 (10% of tests to be ASTM D1556)	8" max	-
Trench backfill traversing subgrades	3" max particle size	-	ASTM D1557, Method C	2 initial tests; further tests as	95% Max Dry Density	ASTM D2922 (10% of tests to be ASTM	One test per 100 feet of trench for	-2% to +2% of optimum water	ASTM D3017 (10% of tests to be	8" max	

<p>Table 1 Materials, Compaction, and Testing Requirements</p>											
Material	Gradation Requirements	Plasticity Requirements	Maximum Density	Maximum Density Test Frequency	Required Field Density	Field Density Test	Frequency	Field Water Content	Field Water Content Test	Lift Thickness	Remarks
of streets, roads, railroads, parking areas, underground piping, underground electrical ducts and conduit				directed		D1556)	each lift	content	ASTM D1556))		

02342 - High Density Polyethylene (HDPE) Geomembrane Liner

02342.1 General

02342.1.1 Scope of Work

The work under these specifications shall include furnishing the following for the HDPE Geomembrane Liner System:

Geomembrane Liner Subgrade in accordance with Section 02220 – Earthwork and GRI Test Method GM13, Rev. 13, November 2015

Supply and installation of 60 mil HDPE Conductive Geomembrane Liner including all liner welds

Supply and installation of liner interfaces with all pipe penetrations including pipe boots and concrete collar

Supply of Polylock embedment material

Extrusion Field Welding of Polylock embedment joints

Supply and installation of ballast pipe including ballast sand

Supply and installation of the Concrete Anchor trench

Independent Quality Control (QC), Construction Quality Assurance (CQA), Inspection, and Testing of Liner System and Leak Detection System

02342.1.2 Items Furnished by Others and Interfaces

Items furnished by others and not in this scope of supply include the following:

Soil required for construction of the earthen berms will be supplied by the Owner from the onsite stock pile. Contractor is responsible for hauling and loading/unloading of the material.

02342.1.3 Performance and Design Requirements

Performance and design requirements for the Geomembrane Liner are indicated in Article 02342.1.5.

02342.1.4 Codes and Standards

Work performed under these specifications shall be done in accordance with the codes and standards indicated in these specifications. Unless otherwise specified, the applicable governing edition and addenda to be used for all references to codes or standards specified herein shall be interpreted to be the jurisdictionally approved edition and addenda. If a code or standard is not jurisdictionally mandated, then the current edition and addenda in effect at the date of this document shall apply. These references shall govern the work except where they conflict with the specifications. In case of conflict, the latter shall govern to the extent of such difference:

02342.1.5 Materials

The following materials shall be used:

General	
Component	Material

General	
Component	Material
Geomembrane Liner	High density polyethylene (HDPE)

Specific	
Raw Materials	
Specific gravity, g/cm ³ , without carbon black	≥0.932 per GRI GM13
Carbon black content, percent	2 to 3 per GRI GM13
Melt index, g/10 min	Less than 1.0 gm, other
Carbon black dispersion	Nine of ten views shall be Category 1 or 2. No more than one view from Category 3.
HDPE Geomembrane Liner Physical Properties	
Thickness, mil	60 mil
Specific gravity, g/cm ³	≥.94 per GRI GM13
Geomembrane surface	Textured top surface, untextured bottom surface
HDPE Geomembrane Liner Mechanical Properties	
Tensile strength, yield, ppi	≥132 ppi
Tensile strength, break, ppi	≥115 ppi
Elongation at yield, percent	12, +/-10%
Elongation at break, percent	≥100% GRI GM13
Tear resistance, (N)	200
Low temperature impact, °F	<-77° per ASTM D746 Certify to Only
Environmental stress crack, hours, Condition C	300, +/-10%
Puncture resistance, (N)	108, +/-10%
Design Requirements	
Temperature compensation range, °F	Minus 26, plus 96
Allowance for sheet stability, percent	2
Maximum wind speed, mph	90
Water level, ft	Maximum elevation 34 and Minimum elevation 28

Geomembrane temperature range for seaming, °F (°C)	Per Manufacturer's Recommendation
General Data	
The liner shall be used as a	Fuel Oil Secondary containment liner
Number of samples for liner degradation monitoring	3
Design requirements	
Material Warranty	
Duration of material warranty after Substantial Completion, years	10
Sampling and Testing	
Seam testing	
Length of test weld, ft	6
A sample coupon of production seams shall be taken every, ft	1,000
Samples obtained from double fusion and extrusion welded seams shall exhibit at least	
Percent of the minimum sheet tensile yield strength in shear	90
Percent in peel (fusion welded seam)	60
Percent in peel (extrusion welded seam)	60
Frequency of observation of destructive seam testing, ft (m) of seam	400 (120), 500 (150), 1,000 (300), other
Double fusion weld testing	
Test pressure, psi	30
Test time, min	5
Allowable pressure drop during test, psi	3
Contractor experience	
Installation supervisor minimum installation experience, square feet	2,000,000
Conformance testing	
Sample frequency, sq ft	50,000
Conformance tests	
Thickness	Manufacturer

Tensile strength	Manufacturer
Tensile elongation	Manufacturer
Puncture resistance	Manufacturer
Tear resistance	Manufacturer
Production seam testing	Yes

02342.1.6 Acceptable Manufacturers of Components

For the following components, the manufacturers listed below provide examples of the quality of workmanship required by these specifications. If the Contractor wants to propose a nonlisted manufacturer that is considered to provide an equivalent level of quality, this manufacturer must be identified and supporting testimony provided. Acceptance of the manufacturer as a substitute is at the discretion of the Owner:

Component	Manufacturer
HDPE Liner	GSE Lining Technology Poly-Flex, Inc. Agru America

02342.1.7 Test Requirements

The following testing shall be conducted in accordance with the specified source. This testing is to be considered part of the defined scope of work, and all associated costs are the responsibility of the Contractor:

Tests	In Accordance With	Conducted By
Specific gravity	ASTM D1505/792 Method B	Contractor
Carbon black content	ASTM D1603	Contractor
Melt index	ASTM D1238	Contractor
Carbon black dispersion	ASTM D5596	Contractor
Thickness - smooth	ASTM D5199	Contractor
Thickness - textured	ASTM D5994	Contractor
Tensile strength	ASTM D638, Type IV	Contractor
Tear resistance	ASTM D1004	Contractor
Low temperature impact	ASTM D746	Contractor
Stress crack resistance	ASTM D5397	Contractor
Puncture resistance	ASTM D4833	Contractor
Dimensional stability	ASTM D1204	Contractor
Continuous vacuum box extrusion welded seams	ASTM D4545	Contractor

Tests	In Accordance With	Conducted By
Bond shear strength for seams and seam peel adhesion	ASTM D6392	Contractor
Air pressurized testing on all double fusion welded seams	ASTM D5820	Contractor
Ultrasonic testing on extrusion welded seams that do not permit vacuum box testing (short slopes, corners or details)		Contractor
Liner degradation monitoring (applies to pond liners and/or landfill liners)		Contractor
Oven aging at 85° C	ASTM D5721	Contractor
Test method for rubber property effect of liquids	ASTM D471	Contractor
Oxidation Induction Time - Standard	ASTM D3895	Contractor

02342.1.8 Technical Attachments

Technical attachments relevant to the work under this section are listed in Section 01100.

02342.1.9 Supplemental Specifications

Technical supplemental specifications that are applicable to the work covered under this technical specification section are identified and included in Section 01400.

02342.2 Products

02342.2.1 General

This section covers the material requirements for both smooth and textured HDPE geomembrane material as specified in Article 02342.1.5. The geomembrane shall be installed to the limits indicated on the drawings in accordance with the manufacturer's recommendations and these specifications.

The geomembrane manufacturer shall have a minimum of 5 years experience in satisfactory production of a minimum of 10,000,000 square feet of geomembrane similar to the type specified. The Contractor or the Contractor's subcontractor shall be the geomembrane manufacturer, or an installer acceptable to the manufacturer.

02342.2.1.1 Quality Control. Quality control (QC) shall be performed by an independent firm contracted by the Contractor and acceptable to the Owner in accordance with these specifications. Quality control testing requirements and frequency shall be in accordance with Article 02342.3.5, Field Quality Control. All quality control field and laboratory testing will be performed by an independent testing laboratory secured by the Contractor and acceptable to the Owner.

02342.2.2 Drawings and Data

The Contractor shall submit drawings, manufacturer specifications, and data for the geomembrane and all accessories to the Owner in accordance with Article 02342.4. The installation drawings shall indicate the extent, size, and details of the proposed panel layout, panel numbers, seam locations, seam numbers, seam details, penetration details, geomembrane terminations, and all special details. Data shall include current test reports verifying conformance to the material specifications. The Contractor shall furnish "as-built" drawings that record all panel and seam numbers as well as the locations and dimensions of compensation strips, if any.

All changes in submitted installation drawings and procedures must be accepted by the Owner. Requests for field changes to the approved installation drawings, procedures, and schedule shall be submitted in writing to the Owner for review and comment. No changes shall be allowed prior to written acceptance by the Owner. Changes shall be documented on original drawings submitted by Contractor.

02342.2.3 Material Warranty

The geomembrane material shall be warranted on a prorated basis against manufacturing defects and material degradation for the period of time in Article 02342.1.5 from the date of Substantial Completion by the Owner. Material, which fails within 2 years of Acceptance, shall be replaced and installed at no cost to Owner. HDPE geomembrane liner failures shall be replaced on a full panel basis.

02342.2.4 Materials

The sheet shall be extruded so as to produce a uniform sheet free of defects such as holes, tears, punctures, blisters, or other manufacturing defects that may affect its durability. Minimum manufactured sheet width shall be 20 feet.

Physical property requirements for the HDPE geomembrane shall apply to the extrusion material used for joining sheets.

Melting behavior, melt appearance, and forming behavior shall be continuously observed during production of the geomembrane sheets. The data, labeled with the respective batch and sheet roll numbers, shall be assembled as product quality control documentation and be made available in the event of the material failing during installation or while in service. If a batch does not show favorable behavior in all three respects, it shall be excluded from production regardless of previous acceptance. Important extrusion data (processing parameters) including, but not limited to, melt temperature and production rate shall be monitored and made available. The results shall be submitted upon request.

One sample 8 by 12 inches (21 by 30 centimeters) or larger will be excised from the finished roll across the full sheet width. One sample from each roll will be stored with appropriate labeling, and one sample will be tested by the sheet manufacturer for each 50,000 square feet (4,645 square meters) of geomembrane manufactured. This testing will include tensile strength, thickness, and density tests. Test results will meet or exceed the specified minimum requirements.

The values will be documented for each individual sample, stored with the respective sheet report and production report, and submitted upon request. The completed labeled sheet roll will not be placed in storage if any of its test values deviate from the limits. It is the manufacturer's express obligation to exclude any sheet not complying with these quality standards.

A sheet report covering the entire sheet roll shall be prepared for each roll, on which any visible faults must be accurately entered.

A stress cracking durability of range of tolerance equal to or greater than 1,000 hours shall be documented in testing. Test results shall be submitted to the Owner upon request.

The sheet roll shall not be released for installation unless acceptable results of the production control tests are obtained. If unacceptable results are obtained, the test shall be repeated on another sample from the sheet roll in question. If these results confirm a substandard tensile cracking durability, the material shall be rejected.

02342.3 Execution

02342.3.1 Subgrade Preparation

Geomembrane liner materials shall not be placed until the required subgrade preparation has been completed and the Contractor certifies in writing that the surface on which the geomembrane is installed is acceptable. The Owner and Contractor, prior to placing any geomembrane, will perform a walk-through inspection.

It will be the responsibility of the Contractor to keep the previously prepared receiving surface in the accepted condition until the geomembrane installation is complete.

Subgrade prepared for geomembrane installation will be smooth and free of debris, roots, and angular or sharp rocks larger than 3/8 inch in diameter. No sharp stones or other hard objects that will not pass through a 3/8 inch screen will be present in the top 12 inches of the surface to be lined. The subgrade will be protected from erosion. Any areas of the subgrade that are soft, weak; maintain inadequate moisture conditioning; contain ruts, stones, sharp breaks, or holes; or are otherwise unacceptable will be removed or repaired prior to releasing the subgrade for liner installation.

02342.3.2 Delivery and Storage

Upon arrival at the site, the geomembrane rolls shall be unloaded and placed on a smooth surface free of rocks, mud, debris, or any other protrusions which may damage the material. Materials shall not be stored directly on the ground. The Contractor shall provide adequate equipment and personnel at the time of each delivery in order to ensure that the geomembrane is not damaged. Personnel shall handle the geomembrane with care.

Any extrudate delivered to the site prior to the Contractor's mobilization shall be kept covered and dry. The Contractor shall examine all rolls for defects and damage and shall report observed damage to the Owner immediately.

The geomembrane rolls shall be stored onsite at a location that shall be selected to minimize onsite handling. Geomembrane rolls shall not be stacked in a manner that could cause damage to underlying rolls. Geomembrane shall not be stacked higher than two rolls. During storage, the rolls shall be protected from vandalism, passage of vehicle, and theft.

The CQA personnel shall obtain a sample of the delivered material. The rate of sampling will be one sample per 100,000 square feet of material. The sample will be 3 feet in length across the entire roll width. The sample shall be tested for conformance at the request of the Owner. Testing shall include thickness, specific gravity, carbon black dispersion, carbon black content, tensile properties (yield, break, and elongation), tear resistance, and puncture resistance.

02342.3.3 Geomembrane Installation

The geomembrane will be installed in accordance with the manufacturer's recommendations, to the limits indicated on the drawings, and as specified herein.

The geomembrane shall be installed by crews experienced in the installation of HDPE sheet, the type and thickness specified. The onsite installation supervisor shall have supervised in the field or installed at least the square feet of the HDPE liner required in Article 02342.1.5. All seamers shall have at least 500,000 square feet of HDPE geomembrane seaming experience.

Extreme care shall be taken during installation of the geomembrane to be certain no damage is done to any part of the material. Dragging of the geomembrane on the subgrade shall be avoided. Smoking and use of glass containers by installation personnel shall be prohibited. All handling and installation procedures used by the Contractor shall not damage the liner. If damage occurs, the QC personnel shall require changes in

equipment and procedures. No vehicular traffic shall be allowed on the HDPE except for Rubber Tired equipment may be used on the liner to facilitate the installation of the liner. Field testing must be completed after rubber tired equipment is removed from the liner. Testing may begin on portions of the liner once the equipment has been removed from the areas, and closed off to further equipment traffic.. Exceptions shall be as agreed by the Owner. All motor driven equipment using fuel shall have spark arrestors. No gasoline driven generators or cans of gas or solvent shall be placed directly on the HDPE material. Under no circumstances shall the HDPE liner be used as a work area to prepare patches or to store tools and supplies. If needed, a tarpaulin of approved material shall be spread out as a work area.

The Contractor QC personnel shall perform visual inspection of geomembrane materials upon arrival at site for possible transport damage. Geomembrane materials showing damage will be isolated, clearly labeled as damaged, and returned to the manufacturer as determined by the QC personnel. The geomembrane surface will be inspected as it is unpacked or unrolled. If damage or faults not previously observed are discovered, they will be clearly marked and the respective sheet roll will be set aside. Damaged areas will be repaired in a manner acceptable to the QC personnel, or the entire roll shall be returned to the manufacturer as determined by the CQA personnel. All scuffed surfaces resulting from abuse of any kind caused by the Contractor in performance of the work shall be repaired at no additional cost to the Owner.

Installation work shall not begin until all required drawings and data have been submitted and the Contractor has certified the acceptability of the subgrade in writing. The geomembrane shall be installed over the prepared subgrade to the limits indicated on the drawings. Geomembrane panels shall be arranged to minimize field seaming. All geomembrane panels over 25 square feet (2.3 square meters) in area shall be designated with a panel number. The Contractor shall be responsible for assigning the number and shall locate the number near the middle of panels less than 50 feet (15.25 m) in length and at both ends of panels over 50 feet (15.25 m) in length. These numbers shall be noted on "as-built" drawings and daily progress reports and shall correspond to the drawings initially submitted by the Contractor. Any panel under 25 feet square (2.3 square meters) shall be considered a patch and shall not require a panel number; these however will be identified (location and approximate size) on the "as-built" drawings.

Only geomembrane panels scheduled for each day's field seaming shall be spread each day. Panels shall be seamed on the same day they are spread and shall be held in position by sandbags placed at the edges of the sheets until field seaming is complete. Sandbags shall be sufficiently close-knit to preclude fine material from exiting the bag. Metal or wire ties shall not be used.

All rips, tears, punctures, or other injuries to the geomembrane shall be repaired the same day they occur in accordance with procedures as specified herein. At the CQA personnel's discretion, excessive patching shall result in removal and replacement of entire geomembrane sheet at Contractor's expense.

Cleanup within the work area shall be an ongoing responsibility of the Contractor. Particular care shall be taken to ensure that no trash, tools, and other unwanted materials are dragged across or trapped beneath the geomembrane. Care shall be taken to ensure that all scraps of geomembrane material and other installation related debris are removed from the work area.

02342.3.3.1 Installation. The geomembrane shall be installed on prepared subgrade to the limits indicated on the drawings. The geomembrane panels shall be arranged in a manner to minimize the number and length of field seaming. The geomembrane panels shall be installed such that field seams run longitudinally down the embankment slope. The installation shall allow for thermal expansion and contraction of the geomembrane. Adequate compensation for liner thermal effects and sheet stability shall be allowed for by the Contractor. Compensation strips shall be installed as required and shall be clearly noted on the "as-built" drawing.

Prior to liner installation, the Contractor shall provide the QC personnel and the Owner with a table listing the required additional compensation material necessary versus sheet temperature. The minimum design

operating liner temperature for this table shall be -30° F. This table shall include the necessary compensation for sheet stability. No liner shall be installed until the table has been submitted to the QC personnel and the Owner. The Contractor shall install at each pipe penetration, foundation interface, or concrete cover sufficient compensation to eliminate stress at the liner anchorage due to temperature and sheet stability contraction.

The Contractor shall provide temporary wind anchorage during geomembrane installation. All faulty areas shall be repaired. The geomembrane panels shall be installed by experienced workmen and handled carefully. All rips, tears, punctures, or other injuries to the geomembrane shall be repaired the same day to the satisfaction of the QC personnel and in accordance with procedures specified herein.

Liner attachments to structures and penetrations shall be performed by the Contractor in accordance with the drawings.

02342.3.3.2 Seaming. Field seams shall be made by fusion or extrusion welding methods.

Extrusion welding shall only be used in areas where fusion welding equipment cannot operate.

The Contractor shall use only welding apparatus on which proper control of extrudate or wedge temperature, apparatus pressure, welding speed, width of weld, and sheet preheating temperature can be maintained. Certification that the welding apparatus meets these requirements shall be presented before any field seams are made. Welding apparatus or employees shall not damage the geomembrane.

No horizontal seams shall be placed in areas of potential stress concentrations, such as the toe of slopes. The location of horizontal seams shall be discussed with the QC personnel.

A seam numbering system compatible with a panel numbering system shall be established prior to commencing geomembrane installation and submitted to the QC personnel. This information shall be included on the "as-built" drawings and the daily progress reports.

A test weld of length in accordance with Article 02342.1.5, a determination of sheet surface temperature, and visual inspection of the seam surface and cross section shall be performed satisfactorily before any seam welding is begun each day and before startup of any welding equipment after it has been shut down for any time period exceeding 30 minutes. Trial seams shall be made under the same conditions as actual seams. The CQA personnel may require a trial seam be made at any time during seaming production to verify equipment, operator performance, and seam integrity.

Three 1 inch wide specimens shall be cut from the trial seam, each having the seam centrally located. Using a field tensiometer, the specimens shall be tested in peel and shear, respectively. If either of the samples fail in the seam, the operation shall be repeated until the deficiencies are corrected and two successful trial welds are achieved.

After positive evaluation of the test weld, the seaming shall begin.

Before welding, the seam areas will be cleaned of wall dust, dirt, and other foreign materials. Welding shall not be performed unless the sheet is dry and the sheet temperature is within the temperatures specified in Article 02342.1.5. Welding may be required in cold temperatures. Cold temperature welding procedures shall be provided to the CQA personnel for review prior to start of welding. In no case shall seaming continue if the peel and shear tests fail to meet the specified requirements. Panel layout and other preparatory work may be completed with the aid of artificial light (light plants). A visual inspection of the seaming surface and cross section will be performed before any seam welding or equipment startup has begun.

The Contractor may propose seaming procedures for adverse weather conditions, which will be evaluated by the QC personnel prior to use. Work at night shall take place only with acceptable lighting and the Owner approval. All personnel onsite shall be required to carry suitable flashlights during nondaylight hours.

Extrusion field seams shall be made only in areas where fusion seaming is not practical. The sheet surface for extrusion welding shall be roughened by an acceptable means before extrudate is placed. Excessive grinding resulting in grooving of the liner or reducing liner thickness greater than 10 percent shall not be permitted. Grinding shall be performed perpendicular to the seam.

Extrusion seams shall be made by overlapping adjacent sheets a minimum of 3 inches and extruding a ribbon of hot fusion-joining resin no less than 3/4 inch (19 mm) in width between the overlapped sheets or over the seams between the overlapped sheets.

Fusion field seams shall be made by overlapping adjacent sheets a minimum of 3 inches and forming a double welded seam separated by an air space approximately (3/8 inch, one, other) in width. Welded seams shall be produced by a double hot shoe welder capable of maintaining a recordable temperature determined by onsite conditions and shall not vary more than 50° F (10° C) from the target temperature.

Penetrations through the geomembrane for pipe, patches, concrete structures, other structures, etc. will be field welded, using an extrusion weld joint gun. The seaming procedure shall consist of cleaning and roughening the surface, and softening the geomembrane material by application of heated air. Directly following the application of heat, a hot strip of the same HDPE from which the sheet is made will be extruded over the seam to produce the fusion-welded seam.

Repairs of small holes less than 2 inches (51 mm) in the geomembrane surface shall be made with an extrusion joint gun. Geomembrane materials shall be cleaned of all dirt, dust, and other foreign material; all smooth HDPE surfaces roughened, heated to the prescribed temperature, and a hot strip of HDPE resin shall be extruded over the hole to produce a fusion-welded repair.

Larger holes shall be repaired with a HDPE patch and extrusion joint gun. An HDPE patch, meeting the requirements of the HDPE membrane, shall be placed over the hole. The patch shall completely cover the hole, with a minimum clearance between the hole and edge of patch of 3 inches. Membrane and patch material shall be cleaned of all dirt, dust, and other foreign material. All smooth HDPE surfaces shall be roughened, heated to the prescribed temperature, and the patch extrusion welded to the membrane to complete the repair. All patches shall have rounded corners.

02342.3.3.3 Inspection and Testing. Along with observance of the welding parameters, continuous vacuum box testing shall be performed on all extrusion welded seams and air pressure testing on all double fusion welded seams according to Article 02342.1.7, as product control. All double fusion seams will be tested at the pressure required in Article 02342.1.5 over the maximum uninterrupted panel seam length for the time required in Article 02342.1.5. If the pressure drop in the seam is greater than that required in Article 02342.1.5, the leak will be located and the seam retested.

Extrusion welded seams that do not permit vacuum box testing (on short slopes, corners, or details) shall undergo ultrasonic testing similar to the Ultrasonic Shadow Method. The Contractor shall be responsible for submitting the testing method to be used in these instances to the QC personnel.

Weak or unbonded seams shall be repaired with a minimum 6 inch (152 mm) overlay patch and retested. All liner repairs shall be made using patches with rounded corners.

A sample coupon of production seams approximately 36 inches (914 mm) long by 12 inches (305 mm) wide shall be taken in accordance with Article 02342.1.5. The sample coupon shall allow for a total of ten 1 inch (25.4 mm) wide production field seams to be tested. All testing will be performed at the

Contractor's onsite quality control laboratory. A portion of each sample coupon 12 by 12 inches (305 by 305 mm) shall be labeled and submitted to the CQA personnel for archiving purposes.

Five samples shall be tested for bonded shear strength and five samples shall be tested for seam peel adhesion in accordance with ASTM D4437.

The samples obtained from double fusion and extrusion welded seams shall exhibit at least the minimum percent of sheet tensile yield strength in shear required in Article 02342.1.5. The samples obtained from double fusion and extrusion weld seams shall exhibit at least the minimum percent of sheet yield strength in peel required in Article 02342.1.5.

All five of the specimens tested in shear and four out of five of the specimens tested in peel shall fail in film tear bond (FTB), that is, the break should occur in the parent geomembrane. The failure mechanism of the seam shall be ductile in nature, with no indication of crystallization.

Test results shall be submitted as soon as possible to the QC personnel and signed by the Contractor's Quality Control Manager.

If the sample proves defective, by either destructive or nondestructive testing, additional testing shall be performed to determine the extent of the defect. A test section a minimum of 10 feet (3 m) on both sides of the failed seam shall be retested. If these tests pass, the weld between these areas shall be cap stripped. If failure occurs, the testing shall be continued until the extent of the defect is established. All defects shall be repaired to the satisfaction of the QC personnel.

Destructive weld test sample reports shall be delivered to the QC personnel within 48 hours of obtaining the sample from the production seam. The geomembrane shall not be covered until acceptable destructive and nondestructive testing has been completed.

It is the Contractor's obligation to forward to the Owner all weld seam reports, labeled with the weld seam number in accordance with the installation drawings.

Faulty spots shall be repaired by one of the two methods previously specified, patching or filling, and the repaired sections subjected to thorough visual inspection and vacuum box testing.

02342.3.4 Documentation

02342.3.4.1 Sheet Installation. The Contractor shall perform a visual inspection on each liner sheet for puncture, tears, rips, or other injuries. Daily installation progress reports shall be prepared including the following information:

Names and job description of personnel.

Date.

Weather conditions, including range of wind speed and temperature, cloud cover, and precipitation.

Project location.

Panels installed.

Panels seamed, including panel and seam number.

Liner repair (puncture, tears, rips, or other injuries and method of repair).

Field observations.

Roll number.

Copies shall be provided to the QC personnel on a daily basis.

02342.3.4.2 Liner Seaming. Quality control records shall be prepared by the Contractor detailing the initial weld qualification of equipment and welding crews. Daily seam quality control reports shall be maintained on all field seaming including, but not limited to, the following information:

Date.

Project location.

Weld location, seam number, and panel number (including liner repair situations).

Sheet temperature.

Weld crew identification.

Weld machine identification.

Weld samples, if taken (including test weld documentation).

General observations.

02342.3.5 Field Quality Control

This article describes the activities necessary to monitor the construction of the geomembrane. Specific tests mentioned in this section shall be performed by the Contractor's Independent QC personnel as part of the construction quality control for the project. Additional confirmation tests may be performed by the CQA personnel.

02342.3.5.1 Preconstruction. Preconstruction activities for the liners include observation of the raw materials, manufacturing operations, fabrication operations, and final product quality; observations related to transportation, handling, and storage of the synthetic liner; monitoring of the subgrade (base) preparation; and evaluation of the personnel and equipment to be used to install the liners.

These activities are discussed in the following articles.

02342.3.5.1.1 Quality control of manufacturer. The Contractor must provide documentation confirming that the raw materials comply with the manufacturer's product properties and performance requirements. The manufacturer must have a manufacturing quality control program that the CQA personnel will review. If there are areas where the QC personnel feel that the manufacturer's quality control program is weak, they may request that the manufacturer conduct additional tests.

The liner will be tested by the manufacturer after it is manufactured into rolls and these documented test results reviewed by CQA personnel for compliance with the test methods and properties included in the specifications.

The synthetic liner manufacturer shall retain a sample of the finished liner from each raw material batch (identified by lot number) for future reference. Appropriate documentation (e.g., product specifications, lot number) will be included with each sample. Documentation will be available to the QC personnel.

No factory seam of the synthetic liners will be allowed. The QC personnel shall observe the synthetic liner material for the presence of factory seams.

02342.3.5.1.2 Transportation and storage. CQA personnel will confirm that the synthetic liner has been protected with appropriate covering material. The roll of finished liner material must be marked to show the following minimum information:

Name of manufacturer.

Product type.

Product thickness.

Manufacturing batch code.

Date of manufacture.

Physical dimensions (length and width).

The liner material will be observed to confirm that it is not damaged by the following:

Punctures from handling, nails, splinters, etc.

Tears from operation of equipment or inadequate packaging.

Exposure to temperature extremes resulting in unusable material.

Blocking resulting from the bonding together of adjacent membrane layers due to excessive heat and pressure.

Crumpling or tearing from inadequate packaging support.

When damage to a roll cover has occurred, examination of the underlying material will be conducted. If damage is found, CQA personnel will examine the entire shipment for damage.

The CQA personnel shall review delivery tickets and quality control documentation to confirm if the liner rolls received onsite meet the project specifications. Samples of the product may be "fingerprinted" and compared with the fingerprint of the product originally contracted for. If these fingerprints are different, the material will be rejected.

The CQA personnel shall confirm if the synthetic liner material is stored in a secure area with provisions for protection from adverse weather to avoid damage caused by heavy winds, precipitation, temperature extremes, vandals, and any other causes.

02342.3.5.2 Construction. The observations and tests necessary to detect defects during construction are discussed in the following articles.

02342.3.5.2.1 Synthetic liner placement. Identifying labels from each roll will be taken and saved for future reference. Further, the position of each roll of material will be noted on a final installation drawing.

This document can be used for future reference. Monitoring activities that are necessary and that will be documented during liner placement include the following:

Written acceptance by the Contractor that subgrade is in a condition suitable for liner deployment.

Observations regarding the liner placement plan.

Observations of the weather conditions (i.e., temperature, humidity, precipitation, and wind) and that they are appropriate for liner placement and seaming.

Observations and measurements of the anchor trench so that it is as specified in the construction drawings; that trench corners are rounded to limit stressing the membrane; and that backfilling of the trench is performed as soon as possible and compacted with care so as not to damage the liner.

Observations and tests to confirm that all designed liner connections are appropriately installed.

Measurements to confirm that the required overlaps of adjacent synthetic liner sheets were achieved, that proper temporary anchorage was used, that specified temporary and final seaming materials/techniques were used, and that the synthetic liner was placed in a relaxed (nonstressed) state.

As each synthetic membrane panel is placed, it shall be inspected for tears, punctures, and thin spots. To accomplish this, the panels will be traversed by CQA personnel in such a way that the entire surface is observed.

If the weather becomes unacceptable for installation of the liner, the QC personnel will stop the synthetic liner installation until conditions again become favorable, thus minimizing the potential for unacceptable installation.

02342.3.5.2.2 Liner seaming. The following will be documented by the Contractor during field seaming operations:

Observations that the membrane seaming areas are free from dirt, dust, and moisture.

Observations that the seaming materials and equipment are as specified.

Observations that the seaming placement plan was followed.

Observation that a firm foundation, free from sharp rocks, debris or other deleterious material supports the liner.

Observation of weather conditions.

Measurement of temperatures, pressures, and speed of seaming, when applicable, and that they are as specified (e.g., gauges and dials will be read and readings recorded).

Measurement of the curing time between seaming and seam testing.

Observation of the liner to detect damage caused by equipment or personnel during the seaming process.

Observation of the startup testing of welding equipment including peel and shear testing of sample welds.

Observation of field seam installation so that a homogeneous bond was formed.

Observation of nondestructive tests on 100 percent of the field seams. Failed seams will be recorded as to location and seaming crew and equipment. The data will be reviewed for possible patterns. Repairs will be made in accordance with approved techniques and retested to confirm their integrity.

Observation of destructive seam testing at frequency required in Article 02342.1.5. If different seaming techniques are used, additional tests in accordance with seaming type will be added. Additional test locations and shorter testing frequency may be necessary at the QC personnel's discretion. Test locations and testing frequency will be based on suspicion of contamination by dirt or moisture, change in seaming materials, increase in ambient temperature, increase in failed nondestructive tests, and other causes that could result in unacceptable seams.

Confirmation that destructive seam samples are large enough for the installer to test in the laboratory, for an independent laboratory evaluation and for site owner archiving. Seam samples will be a minimum of 12 inches (305 mm) wide by 36 inches (914 mm) long.

Confirmation that testing is performed in accordance with design specifications with predetermined pass/fail values. Both peel and shear testing should be performed as specified.

Confirmation that for field seams that fail, the installer did go on either side of the failed seam location (10 foot [3 m] minimum), take another sample, test it and if it passes, cap strip the seam between the two locations. Acceptable seams must be bounded by two passed-test locations, unless the capped seam extends to the edge of the lining.

Confirmation that repairs are performed as soon as possible and in accordance with the specifications. Each repair will be nondestructively tested for continuity. Documentation of all repairs including location, type, and method used will be made.

02371 - Seeding and Erosion Control

02371.1 General

02371.1.1 Scope of Work

Scope of work shall include furnishing materials, labor, incidentals and equipment required to perform erosion control work, in accordance with applicable laws, ordinances and this specification.

Scope of Work
Prepare the seedbed soil
Furnish and install seed, fertilizer, mulch, and tackifiers
Furnish and install erosion control blankets
Water and maintain vegetative growth until acceptance by Owner
Other site-specific erosion controls

The extent of seeding and erosion control materials shall be as indicated on the drawings listed in Article 02371.1.2.

02371.1.2 Technical Attachments

Technical attachments relevant to the work under this section are listed in Section 01100.

02371.1.3 Not Used

02371.1.4 Additional Requirements

Additional requirements for the seeding and erosion control work are indicated herein:

Seeding method	FDOT Standard Specifications for Road and Bridge Construction 2016 Section 570, Grassing (By Seeding)
Seed mixture	FDOT Standard Specifications for Road and Bridge Construction 2016 Section 570, Grassing (By Seeding)
Seed application rate	FDOT Standard Specifications for Road and Bridge Construction 2016 Section 570, Grassing (By Seeding)
Fertilizer	FDOT Standard Specifications for Road and Bridge Construction 2016 Section 570, Grassing (By Seeding)
Mulch method	FDOT Standard Specifications for Road and Bridge Construction 2016 Section 570, Grassing (By Seeding)
Mulch application rate	FDOT Standard Specifications for Road and Bridge Construction 2016 Section 570, Grassing (By Seeding)

Erosion control blankets	FDOT Standard Specifications for Road and Bridge Construction 2016 Section 570, Grassing (By Seeding)
Sodding Method	FDOT Standard Specifications for Road and Bridge Construction 2016 Section 575, Sodding
Water Supply Responsibility	Contractor
Guarantee period	1 year

02371.2 Products

02371.2.1 General

All seeding and erosion control work shall be performed by a contractor who is experienced and regularly engaged in the type of work specified and whose work is acceptable to the Owner. The work shall be performed using acceptable equipment manufactured expressly for its intended purpose.

Contractor shall not start seeding and erosion protection or preparatory work until authorized by the Owner. Materials for seeding and soil erosion protection include topsoil, lime, and fertilizer, seed, mulch, tackifiers and erosion control blankets.

02371.2.2 Topsoil

Topsoil imported to the site shall be fertile, friable, natural loam containing a liberal amount of humus and shall be capable of sustaining plant growth. Topsoil shall be free of subsoil and shall be reasonably free of stone, lumps, clods of hard earth, plants or their roots, stalks, and other extraneous matter.

02371.2.3 Lime

Agricultural limestone or agricultural hydrated lime shall be applied prior to or during soil preparation. Liquid lime may be used with hydraulic applications.

02371.2.4 Commercial Fertilizer

Fertilizer shall be a commercial mixture. The percentage of nitrogen, phosphorus and potassium in the fertilizer and the application rate shall be as specified herein. Additional nutrients shall be added to account for any deficiencies in the soil condition. Fertilizer shall be uniform in composition, free flowing, and suitable for application with acceptable equipment.

02371.2.5 Seed

All seed shall meet the requirements of the seed laws of the State of Florida and the requirements of the following specifications.

All seeds shall equal or exceed the percentage of sproutable seeds as indicated in the tabulation that follows. The percentage of either germination or purity may vary slightly from that indicated, provided the product of percent germination times percent purity shall not fall below the specified minimum sproutable seed. The germination and purity of all seeds used shall be determined by accepted laboratory test methods.

Minimum Sproutable Seed and Germination Period				
Sproutable Seed	Germination Period (Days)	Percent Purity	Percent Germination	Percent Sproutable Seed
All Bahia Grass	21 to 28	95	80	76.50
Annual Type Ryegrass	5 to 7	95	90	85.50

Seeding and fertilizing shall not be done during periods of such severe drought, high winds, or excessive moisture, as determined by the Owner, that satisfactory results are not likely to be obtained.

Seed shall be applied at the rate specified by the manufacturer for the mixture stipulated below:

Seed Mixture		
	April thru September (Percent by Weight)	October thru March (Percent by Weight)
Bahai Grass (Tifton 9)	66	66
Annual Type Ryegrass	33	33

The balance of material in an acceptable seed mixture (other than specified pure live seed) shall, for the most part, consist of nonviable seed, chaff, hulls, live seeds of crop plants, and harmless inert matter. The percentage of weed seed shall not exceed 1 percent by weight for the mixture. Seed that is wet or moldy or that has been otherwise damaged in transit or storage will not be acceptable.

02371.2.6 Mulch

Mulching materials shall conform to the following requirements.

02371.2.6.1 Vegetative Mulch. Vegetative mulch shall consist of straw or hay free from rot or mold and shall be in a good state of preservation when used. Vegetative mulch shall be primarily long, heavy stemmed material delivered in dry bales and shall be kept dry until applied. Vegetative mulch shall be as free as practicable from weed seed and other deleterious substances.

02371.2.6.2 Wood Cellulose or Paper Fiber Mulch. Wood cellulose or paper fiber mulch, for use with the hydraulic application of grass seed and fertilizer, shall consist of specially prepared wood cellulose or paper fiber, processed to contain no germination prohibiting factors, and dyed an appropriate color to facilitate visual metering of application of the materials. Mulch shall be manufactured so that after addition and agitation in slurry tanks with fertilizers, grass seeds, water, and any other acceptable additives, the fibers in the material will become uniformly suspended to form homogenous slurry. Mulch shall be of such a consistency that when hydraulically sprayed on the ground, the material will form a blotter-like ground cover impregnated uniformly with grass seed, which, after application, will allow the absorption of moisture and allow water to reach the underlying soil.

02371.2.7 Tackifiers

Organic and polyacrylamide polymer tackifiers may be added to the slurry mixture when hydraulic applications of grass seed or mulch are used. Selection of a tackifier shall be based on the slope conditions at the site, the type of mulch and the mulch application rate. Slurry mixtures that include tackifiers and paper fiber mulch shall be designed to prevent the formation of a "paper mache" crust over the seeded area. Organic or polyacrylamide tackifiers may also be used with straw and hay mulches.

02371.2.8 Erosion Control Blankets

Erosion blankets shall conform to the following requirements.

02371.2.8.1 Straw Mats. Straw mat material shall be machine produced with the straws interlocking to form a continuous web. Straw shall be well preserved and free of mold or rot. The web of fibers shall be distributed uniformly throughout the mat, resulting in a mat of uniform thickness and density. Mats shall be covered on one side with photodegradable netting, which shall not exceed a mesh size of 1 1/2 inches by 1 1/2 inches. Mats shall be furnished in rolls 90 inches wide with a length of not less than 120 feet. The dry weight shall be approximately 0.50 pound per square yard.

Mats shall be smolder resistant. The smolder resistant treatment shall be non-leaching and shall be non-injurious to vegetation, animals, and humans.

Mats shall be held in place with "U" shaped staples made from No. 11 gauge or heavier bare wire. The wire shall be bent in the center to form a "U" 1-1/2 to 2 inches wide. The staples shall be 10 inches long for sandy soil and 6 inches long for other soils.

02371.2.8.2 Excelsior Mats. Excelsior mat material shall be machine produced with the excelsior fibers interlocking to form a continuous web. A minimum of 80 percent of the fibers shall be at least 8 inches long. The web of fibers shall be distributed uniformly throughout the mat, resulting in a mat of uniform thickness and density. Mats shall be covered on one side with photodegradable netting which shall not exceed a mesh size of 3 inches by 3 inches. Mats shall be furnished in rolls 90 inches wide with a length of not less than 120 feet. The dry weight shall be approximately 0.85 pound per square yard.

Mats shall be smolder resistant. The smolder resistant treatment shall be non-leaching and shall be non-injurious to vegetation, animals, and humans.

Mats shall be held in place with "U" shaped staples made from No. 11 gauge or heavier bare wire. The wire shall be bent in the center to form a "U" 1-1/2 to 2 inches wide. The staples shall be 10 inches long for sandy soil and 6 inches long for other soils.

02371.2.8.3 Jute Mesh. Jute mesh shall be a uniform, open, plain weave of new and unused smolder resistant non-leaching single jute yarn. The yarn shall be loosely twisted and shall be reasonably uniform in diameter. Jute mesh shall be furnished in 48 inch wide rolls at least 150 feet long with a weight of at least 0.9 pound per square yard. There shall be a minimum of 76 warp ends per 48 inch width with approximately 41 woof ends per linear yard.

Mats shall be held in place with "U" shaped staples made from No. 11 gauge or heavier bare wire. The wire shall be bent in the center to form a "U" 1-1/2 to 2 inches wide. The staples shall be 10 inches long for sandy soil and 6 inches long for other soils.

02371.3 Execution

02371.3.1 Preparation of Soil

The area to be planted shall be thoroughly tilled to a depth of at least 3 inches by disking, harrowing, or other acceptable methods until the soil is well pulverized. After completion of the tilling operation, the surface shall be cleared of all stones, stumps, or other objects larger than 1-1/2 inches in thickness or diameter, and of roots, wire, grade stakes, and other objects that might be a hindrance to maintenance operations. Any undisturbed areas with a satisfactory cover of native grasses shall be left uncultivated and unplanted.

When indicated on the drawings or herein, topsoil shall be spread over the entire area to be planted before the beginning of soil preparation.

Lime shall be added to the soil in amounts required to raise pH to a level acceptable for planting.

02371.3.2 Fertilizing

Commercial fertilizer of the type specified shall be distributed uniformly over the entire planting area. The fertilizer shall be applied with a fertilizer drill before the beginning of the mulching operation as a part of the soil preparation, or if a seed drill with a fertilizer attachment is used, fertilizer may be applied with the seeding operation following the mulching.

If seed is to be applied by hydraulic application, the fertilizer may be mixed with the seed and mulch and applied as a slurry as specified in the article titled Wood Cellulose or Paper Fiber Mulch.

02371.3.3 Seeding

Seed shall be applied uniformly at rates specified herein.

Drills shall deliver seeds uniformly in each drill furrow so that seeds are covered not to exceed 1/2 inch deep. When drilling seed, provisions shall be made by markers or other acceptable means to assure that successive planted strips will overlap or be separated by a space not greater than the space between rows planted by the equipment being used. If inspection during planting operations, or after there is a show of green, indicates that strips wider than the space between planted rows have been left or other areas skipped, additional seed shall be planted in such areas. On slopes too steep for the practical operation of power drawn equipment, grass seed shall be broadcast uniformly by hand methods and raked into the surface or by hydraulic seeding. Ditch bottoms and slopes 4:1 or steeper shall be sodded with Bahia Sod per Article 02371.2.7.

Hydraulic application of seeds shall be in accordance with recommendations of the seed supplier and the manufacturer or the hydraulic application equipment.

02371.3.4 Compacting

Immediately after drill or broadcast seeding operations have been completed, the entire area shall be compacted by means of a cultipacker, roller, or other acceptable equipment.

02371.3.5 Mulching

Mulching shall be performed within 24 hours after seeding, but shall not be done during windy or rainy weather. If the seedbed has become crusty, eroded, or disturbed by the Contractor's operations before mulching, the Contractor shall rework the soil and reseed in these areas. Mulching shall be started at the windward side of relatively flat areas or at the upper part of steep slopes and shall continue uniformly until each area is covered.

02371.3.5.1 Vegetative Mulch. Alternate methods of placing vegetative mulching follow.

Baled straw or hay shall be broken up and loosened sufficiently before being fed into the blower hopper to avoid the placing of matted or unbroken clumps. The use of wet straw or hay is prohibited.

The mulch and tackifier shall be placed with conventional mechanical equipment, which will distribute the mulch uniformly by blowing it onto the area. The equipment shall be provided with jet nozzles spaced in the muzzle of the blower, through which the tackifier is ejected simultaneously with the mulch, coating the mulch uniformly. Small areas may be mulched by hand by spreading the mulch in a loose, fluffy condition and sprayed with the tackifier over the surface of the mulch.

Vegetative mulching material without tackifier may also be used provided that it is disked or punched into the soil so it is partially covered. Several passes may be required, if a straight disk is used, in order to

mix the mulching material with the topsoil sufficiently to ensure protection from erosion by either wind or water. The mulch tilling operation shall be performed parallel to the ground contours.

Under some circumstances, it may become desirable to apply straw or hay mulch and anchor it into the soil on steep slopes to prevent erosion as soon as construction of the slopes is completed as determined by the Owner.

02371.3.5.2 Wood Cellulose or Paper Fiber Mulch. Wood cellulose or paper fiber mulch, for use with the hydraulic application of grass seed and fertilizer, shall be applied uniformly. The fiber mulch, fertilizer, and seed mixture shall be mixed with water to form slurry to be applied under pressure. Hydraulic equipment used for the application of the slurry shall have a built-in agitation system. The slurry distribution lines shall be large enough to prevent stoppage and shall be equipped with a set of hydraulic spray nozzles that will provide even distribution of the slurry on the slopes to be mulched.

02371.3.6 Erosion Control Blankets

Mats shall be placed over the specified areas within 24 hours after seeding.

Mats shall be rolled loosely over the required areas. Lifting and stretching of the material will not be permitted. Mats may be placed parallel with the direction of the flow of water.

The edges of excelsior mats shall be tightly butted together. Mats shall be secured by staples spaced 3 to 4 feet apart in three rows for each strip with the middle row spaced alternately. Check slots will not be required; a row of staples spaced on 6 inch centers across the width of the mat shall be used instead.

The edges of jute mat strips shall be overlapped a minimum of 3 inches with the lap joints made in the direction of water flow wherever practicable. Anchor slots and check slots shall be excavated in accordance with the manufacturer's instructions prior to placing mats. Anchor and check slots shall be placed at right angles to the direction of flow of water prior to placing the mat on the surface. The jute mat shall be secured by staples spaced 3 to 4 feet apart in three rows for each strip with the middle row spaced alternately. Anchor slots, check slots, junction laps, and terminal folds shall be stapled not more than 9 inches apart.

02371.3.7 Sodding

Ditch bottoms and slopes 4:1 or steeper shall be sodded with Bahia Sod.

Sod placed on slopes 2:1 or steeper and in ditch bottoms shall be staked with six (6) stakes per square yard or roll of sod. Sod placed on slopes flatter than 2:1 shall be staked with from two (2) to four (4) stakes per square yard or roll, as determined by the Site Manager. Staked shall be of lath or similar materials and shall be driven six inches (6") in the ground. Sod may also be staked using wired stapled of 11-gage ungalvanized wire. Staples shall be driven flush with the ground.

Strips of sod shall be hand laced tightly against curbs, pavements, foundations, or previously placed sod strips such that the entire area designated to be sodded will be completely covered. Sod shall be placed to match elevations of existing grass sod. Joints in successive rows of sod shall be staggered in a running bond pattern such that the ends of the strips being placed will line up with the centerline of the strips placed in adjacent rows. Ends and edges of sod shall be top dressed with soil to prevent drying as needed.

After placing, all sod shall be firmed by use of an approved roller, a tamper or other approved methods. On steep slopes the sod may be firmed by compacting with sod tampers or hand shovels. The firming process shall ensure good sod-soil contact and allow optimum establishment and rooting of grass.

02371.3.8 Watering

Watering will be required to promote the establishment of healthy turf. Areas that have been vegetated shall be watered such that water will penetrate into the soil.

Additional applications of water will be required until the grass is well established after planting.

Contractor shall furnish all pipes, pumps, hoses, sprinklers, and other materials necessary to apply water.

02371.3.9 Maintenance and Protection

Contractor shall maintain all planted areas until Acceptance of the work. Any portions of the areas of planting which fail to show a fairly uniform stand of grass that is expected to fill in within one growing season by natural spreading shall be replanted as before, except commercial fertilizer shall be applied at one-half the original rate.

Care shall be taken to avoid overwatering on the sloped areas to prevent erosion. Any areas that have become eroded shall be regraded and replanted. Topsoil shall be added if required.

02371.3.10 Guarantee

Contractor shall guarantee all work and materials for a period specified herein after completion of the erosion control work. During the guarantee period, turf that dies shall be replaced by and at the expense of Contractor. Replacement made under the Contractor's guarantee shall be covered by a like guarantee for the same period of time as the original guarantee after completion of the replacement.

03210 - Concrete Reinforcement

03210.1 General

03210.1.1 Scope of Supply

Scope of supply shall include furnishing concrete reinforcement and appurtenances and shall include other services as specified under these technical specifications.

03210.1.2 Not Used

03210.1.3 Performance and Design Requirements

Performance and design requirements for the equipment and materials to be furnished under this section of these specifications are indicated below:

Deliverables	
Reinforcement detailing (placement drawings and cut sheets	Included
Field placement of reinforcement	Included
Mechanical couplings	Included
Bar supports	Included
Reinforcing steel sizes indicated on drawings, in.	US standard units
Billet steel bars, grade	60
Low alloy steel bars, grade	60
Shop coatings for reinforcing steel	None
Mechanical splices shall develop	125 percent of reinforcement yield strength

03210.1.4 Codes and Standards

Work performed under these specifications shall be done in accordance with the following codes and standards. Unless otherwise specified, the applicable governing edition and addenda to be used for all references to codes or standards specified herein shall be interpreted to be the jurisdictionally approved edition and addenda. If a code or standard is not jurisdictionally mandated, then the current edition and addenda in effect at the date of this document shall apply. These references shall govern the work except where they conflict with the Owner's specifications. In case of conflict, the latter shall govern to the extent of such difference:

Work	In Accordance With
Fabrication of reinforcement and appurtenances	ACI 301, Structural Concrete for Buildings; ACI 315, Details and Detailing of Concrete Reinforcement; ACI 318, Building Code Requirements for Reinforced Concrete

03210.1.5 Materials

The following materials shall be used:

Component	Material
Reinforcing steel	
Billet steel	ASTM A615
Bar supports	CRSI Class 3 unexposed, Class 1 exposed
Mechanical splices	Metal filled or threaded couplers, designed for a minimum of 125 percent of the bar yield strength
Welded wire fabric	ASTM A185 or A497

03210.1.6 Approved Manufacturers of Components

For the following components, only the listed manufacturers are recognized as maintaining the level of quality of workmanship required by these specifications. If the Contractor wants to propose a nonlisted manufacturer that is considered to provide an equivalent level of quality, this manufacturer must be identified and supporting testimony provided. Acceptance of the manufacturer as a substitute is at the discretion of the Engineer:

Component	Manufacturer
Mechanical splices - metal filled	Erico Products Cadweld
Mechanical splices - threaded coupler	LENTON® taper threaded couplers as manufactured by ERICO (http://www.erico.com/erico_public/general_info/CouplersEStdA12.asp) or Dayton Richmond Dowel Rebar splicing Products (http://www.daytonrichmond.com/products/default.html)

03210.1.7 Test Requirements

The following testing shall be conducted in accordance with the specified source. This testing is to be considered part of the defined Scope of Work, and all associated costs are the responsibility of the Contractor:

Tests	In Accordance With	Conducted By
Coated Reinforcing Bars Certification	ASTM D3963	Manufacturer
Tensile Tests	ASTM A615 and A706	Manufacturer

03210.1.8 Technical Attachments

Technical attachments relevant to the work under this section are listed in Section 01100.

03210.1.9 Supplemental Specifications

Technical supplemental specifications that are applicable to the work covered under this technical specification section are identified and included in Section 01400.

03210.2 Products

03210.2.1 Work Included Under These Specifications

The work under this specification shall include furnishing concrete reinforcement and providing miscellaneous materials and services complete as specified. The concrete reinforcement furnished under these specifications may be installed by several sub-contractors. Concrete reinforcement shall be delivered to designated lay-down areas at the construction site.

03210.2.2 Materials

03210.2.2.1 Reinforcing Steel. Straight bars of all diameters and bent bars with a diameter less than 1-1/2 inches (38 mm) shall be deformed billet steel bars. Bent bars with a diameter greater than 1-1/2 inches (38 mm) shall be deformed low alloy steel bars.

Reinforcing steel shall be accurately formed. The details of fabrication shall conform to the codes and standards specified.

03210.2.2.2 Not Used. .

03210.2.2.3 Accessories. Bar supports, standees, ties, spacers, bolsters, inserts, and other concrete accessories used to secure reinforcing in position shall be furnished.

03210.2.2.4 Certification. Certification of compliance with these specifications shall be provided for all reinforcing steel furnished. Certification of compliance with all tests required by the material specification shall be included. These tests shall include material composition, bend tests, and tensile tests as a minimum.

03210.2.2.5 Welding. Unless specifically required by the Owner, welding of reinforcement is prohibited. Reinforcement with unauthorized welds shall be removed and replaced.

Welded chairs and supports may be used.

03210.2.3 Placement Drawings and Bar Lists

If detailing is included in the Contractor's bar lists and reinforcement placement drawings shall be prepared and submitted to the Engineer for acceptance. Each bar list and placement drawing shall clearly identify the grade of reinforcing required by that drawing.

03210.2.3.1 Drawing Requirements. Each drawing submitted shall indicate the name of the project, the unit designation, the contract title, the contract number, the name of the building structure, the concrete placement number, and the Contractor's name.

The Owner's identification number will be affixed by the Owner to each Contractor's initially submitted placing drawing. This number shall be maintained on all subsequent drawing submittals in the identical format and location as originally indicated by the Owner.

03210.2.3.2 Reinforcing Spacing. Reinforcement for concrete shall have the concrete protective cover specified in the codes and standards.

The clear distance between individual parallel bars shall not be less than 1.5 times the maximum size of coarse aggregate in the concrete; nor less than one nominal bar diameter; nor less than 1 inch (25 mm) in beams, 1-1/2 inches (38 mm) in columns, or 2 inches (50 mm) in other locations. Where reinforcements in beams are placed in two or more layers, the bars in the upper layer shall be placed directly above the bars in the lower layer and the clear distance between layers shall not be less than

1 inch (25 mm). Clear distance limitations between individual bars shall also apply to the clear distance between a contact lap splice and adjacent splices or bars.

03210.2.3.3 Splices. Splices shall conform to the codes and standards specified. Lap splice lengths shall permit all bars to be spliced at the splice location with no reduction in splice length as a result of staggered splice locations or excess reinforcement unless otherwise indicated on the drawings. Splices in horizontal reinforcement placed in vertical wall sections shall be detailed in accordance with top reinforcement requirements. Splices shall not be used in regions of maximum bending stress.

Splices for bars with a diameter greater than 1-1/2 inches (38 mm) shall be mechanical splices.

Mechanical splices under tension shall develop the minimum strength specified herein. Mechanical splice manufacturer's inspection criteria shall be furnished to the Engineer.

03210.3 Execution

Reinforcement shall be delivered to the jobsite packaged in bundles. Each shipment shall contain all bundles required for one or more concrete placements. Each bundle shall be tagged with a sturdy, durable, weatherproof tag which includes the following information:

Placement number (according to Owner's designation). If bar is a dowel bar, the placement number shall be the first of the two placements.

Bar diameter.

Number of bars in bundle.

Position/Shape number.

Bar length.

Weight of bundle.

Graphical description of bar shape.

Each shipment shall contain a complete bundle-by-bundle inventory that duplicates all the information listed on all the tags of all the bundles listed.

Each bundle shall be securely bound. Every binding shall be capable of safely holding the entire weight of the entire bundle.

03311 - Cast-in-Place Concrete

03311.1 General

03311.1.1 Scope of Supply

Scope of supply shall include receiving and placing concrete, installation of embedments, constructing required formwork, and furnishing materials, equipment, and labor to complete the cast-in-place concrete work including other services as specified herein.

03311.1.2 Not Used

03311.1.3 Performance and Design Requirements

Performance requirements for the cast-in-place concrete shall be as follows:

Component	Material
Mechanical splices shall develop	125 percent of yield strength of spliced bars
Cold weather placement	
Maximum time interval for measuring concrete temperature during the protection period, hours	12 hours
Special structures	The following structures are to be constructed in accordance with the Special Structures provisions specified in Article 03311.3.16:
	Turbine/generator foundations
Finishes for formed concrete surfaces exposed to view	Standard finish (rough form finish
Finishing unformed surfaces	
Screeding	Where indicated on the drawings
Floating	Flat surfaces and floors not otherwise specified
Brooming	Roads, sidewalks, and walkways
Troweling	Where indicated on the drawings
Aggregate exposure	Where indicated on the drawings
Special Coating	Areas requiring special coating will be identified on drawings and installed as per painting specification.

03311.1.4 Codes and Standards

Work performed under these specifications shall be done in accordance with the following codes and standards. Unless otherwise specified, the applicable governing edition and addenda to be used for all references to codes or standards specified herein shall be interpreted to be the jurisdictionally approved

edition and addenda. If a code or standard is not jurisdictionally mandated, then the current edition and addenda in effect at the date of this document shall apply. These references shall govern the work except where they conflict with the Owner's specifications. In case of conflict, the latter shall govern to the extent of such difference:

Work	In Accordance With
Structural concrete for buildings	ACI 301
Structural Concrete within Containment Areas	ACI350.4R04
Hot weather concreting	ACI 305R
Cold weather concreting	ACI 306R and ACI 301
Building code requirements for reinforced concrete	ACI 318
Recommended practice for concrete formwork	ACI 347R
Splices in reinforcing steel	ACI 318
Tolerances	AISC Manual of Steel Construction, Code of Standard Practice, ACI 117, ACI 301, API 650
Finishes and finishing	ACI 301
Sampling and Testing for Strength	ACI 318, Section 5.6

03311.1.5 Materials

The following materials shall be used:

General	
Component	Material
Form ties	Removable end, permanently embedded body type. In liquid retaining structures, provide integral water stops.
Polyethylene sheeting	ASTM D4397, 6 mil (150 µm)
Water stops - PVC Where indicated on drawings	
Construction joints	PVC ribbed or serrated, 6 inches by 3/8 inch (150 mm by 9.5 mm), with "O" bulb closed center section
Expansion or isolation joints	PVC ribbed or serrated, 9 inches by 3/8 inch (229 mm by 9.5 mm), with "O" bulb closed center section
Water stops - hydrophilic	Expanding preformed rubber strip, expansion coefficient by volume exceeding 1.5 when saturated
Expansion joint filler	ASTM D1752, Type 1 sponge rubber or

General	
Component	Material
	closed cell PVC or polyethylene foam
Polyurethane sealant	ASTM C920, Type M, Grade P, Class 25, Use T
Membrane curing compound and floor sealer	ASTM C1315, Type 1, Class A, acrylic copolymer, with a minimum 25 percent solids, nonyellowing, maximum moisture loss 0.40 kg/m ² in 72 hours
Membrane curing compound, dissipating type, where specified herein or indicated on the drawings	ASTM C309, Type 1, Class A, maximum moisture loss 0.55 kg/m ² in 72 hours
Epoxy bonding adhesive (joints between existing and new concrete)	ASTM C881, Types I and V, moisture insensitive, 100 percent solids
Epoxy anchoring system (dowels and anchors)	ASTM C881, Type IV, Grade 3
Anchor bolt sleeves	Plastic

03311.1.6 Approved Manufacturers of Components

For the following components, only the listed manufacturers are recognized as maintaining the level of quality of workmanship required by these specifications. If the Contractor wants to propose a nonlisted manufacturer that is considered to provide an equivalent level of quality, this manufacturer must be identified and supporting testimony provided. Acceptance of the manufacturer as a substitute is at the discretion of the Owner:

Component	Manufacturer
PVC water stops - 9 inch (229 mm)	Vinylex RB9-38, Greenstreak Style 709, and W. R. Meadows Sealtight Type 9380
PVC water stops - 6 inch (150 mm)	Vinylex RB6-316 and Greenstreak Style 716, W.R. Meadows Sealtight Type 6380
Hydrophilic water stops	Adeka Ultra Seal MC 2010MN and Greenstreak Hydrotite CJ 1020
Adhesive anchoring system	Hilti HIT HY-200, Hilti RE 500 SD
Epoxy bonding compound (joints between existing and new concrete)	Sika Sikadur 32 Hi-Mod, Master Builders Concreive Liquid LPL, Euclid Chemical Super Diamond Clear VOX
Form coating	Nox-Crete Form Coating, L&M Debond, Richmond Clean Strip Ultra, Symons Magic Kote

03311.1.7 Required Tests

The following testing shall be conducted in accordance with the specified source. Testing intervals and execution are specified in Article 03311.3.17.

This testing is to be considered part of the defined Scope of Work, and all associated costs are the responsibility of the Contractor. The Contractor will be responsible for all costs associated with correcting deficiencies and retesting in the event of a test failure:

Tests	In Accordance With	Conducted By
Slump test	ASTM C143	Owner
Air content	ASTM C231	Owner
Concrete test cylinders	ASTM C31	Owner
Compression test	ASTM C39	Owner
Compression strength test	ACI 318, Chapter 5	Owner
Concrete temperature	ASTM C1064	Owner

03311.1.8 Not Used

03311.1.9 Supplemental Specifications

Technical supplemental specifications that are applicable to the work covered under this technical specification section are identified and included in Section 01400.

03311.2 Products

Materials and product requirements are provided in Articles 03311.1.5 and 03311.1.6.

03311.3 Execution

03311.3.1 General

Work shall include design and construction of formwork; installation of reinforcing steel and other embedments; concrete placement, finishing, curing and other appurtenant work; and provision of miscellaneous materials and services complete as specified. Concrete reinforcement and embedments are covered in separate sections.

03311.3.2 Placement of Steel Reinforcement

Reinforcement shall be accurately positioned and secured in place with wire ties or suitable clips. Bare metal supports shall not be used in contact with forms for exposed concrete surfaces.

The clear distance between individual parallel bars shall not be less than 1.5 times the maximum size of coarse aggregate in the concrete; not less than one nominal bar diameter; and not less than 1 inch (25 mm) in beams, 1-1/2 inches (38 mm) in columns, or 2 inches (51 mm) in other locations. Where reinforcements in beams are placed in two or more layers, the bars in the upper layer shall be placed directly above the bars in the lower layer and the clear distance between layers shall not be less than 1 inch (25 mm). Clear distance limitations between individual bars shall also apply to the clear distance between a contact lap splice and adjacent splices or bars.

03311.3.2.1 Splices. Splices shall conform to the specified codes and standards. Lap splice lengths shall permit all bars to be spliced at the splice location with no reduction in splice length due to staggered splice locations or excess reinforcement unless otherwise indicated on the drawings. Splices in horizontal reinforcement placed in vertical wall sections shall be spliced in accordance with top reinforcement requirements. Splices shall not be used in regions of maximum bending stress.

Lapped splices shall not be used for bars with a diameter greater than 1-1/2 inches (38 mm). Splices for bars with a diameter greater than 1-1/2 inches (38 mm) shall be made with mechanical splices.

Mechanical splices under tension shall develop the minimum strength specified in Article 03311.1.5. The first four splices made by each operator shall be made in the presence of the mechanical splice manufacturer's representative and the Site Construction Manager. Each operator shall make splices in the same splicing positions (vertical, horizontal, angle, or special) to be made for the project. All procedures used shall be acceptable to the mechanical splice manufacturer's representative and the Engineer.

Reinforcing bar splices shall be welded only when directed by the Engineer.

03311.3.2.2 Not Used

03311.3.2.3 Reinforcement Installed in Hardened Concrete. Reinforcement installed in hardened concrete shall be anchored with the specified epoxy anchoring system. Holes shall be drilled to a depth sufficient to develop the tensile strength of the reinforcing bar as recommended in the manufacturer's literature. Reinforcement shall be installed in accordance with manufacturer's installation instructions. If reinforcement is encountered while drilling existing concrete, drilling shall stop and the Owner shall be contacted. Reinforcement shall not be cut without the Owner's consent.

03311.3.3 Formwork

Forms shall be designed and constructed to produce hardened concrete having the shape, lines, and dimensions indicated on the drawings.

Vertical surfaces of footings extended above finished grade shall be formed.

03311.3.3.1 Construction. Forms shall be sufficiently tight to prevent leakage of mortar and shall maintain position, shape, and alignment during and after placement of concrete.

Suspended members supported by concrete columns or piers shall be formed to allow the column or pier forms to be removed without disturbing the supports for the suspended members.

03311.3.3.2 Form Ties. Form ties shall have sufficient strength, stiffness, and rigidity to support and maintain the form in proper position and alignment without the use of auxiliary spreaders. Outer ends of the permanently embedded portions of form ties shall be at least 1 inch (25 mm) back from adjacent outer concrete faces. Permanently embedded portions of form ties that are not provided with threaded ends shall be constructed to allow the removable ends to be broken off by twisting without chipping or spalling the concrete surface. Form ties shall be acceptable to the Owner.

Form ties in exposed surfaces shall be uniformly spaced.

03311.3.3.3 Edges and Corners. Chamfer strips shall be placed in forms to bevel all salient edges and corners except buried edges and edges that are designated on the drawings to receive special treatment. Equipment bases shall have formed beveled projecting edges for all vertical and horizontal corners unless indicated otherwise on the drawings. Bevel dimensions shall be 3/4 inch by 3/4 inch unless indicated otherwise on the drawings.

03311.3.3.4 Form Removal. Forms shall not be removed from structures until the concrete in the structure has sufficient strength to support the weight of the structure and any superimposed load, including loads from construction operations. The Contractor shall be responsible for limiting any applied loadings. There shall be no evidence of damage to concrete and no excessive deflection or distortion of members due either to the removal of forms or to loss of support.

Supporting formwork shall not be removed from horizontal members until the concrete has attained at least 75 percent of the specified 28 day compressive strength as determined by cylinders made and cured in the field. Shores shall not be removed before concrete has attained 28 day compressive strength as specified herein. Shoring shall be left in place and reinforced as necessary to carry any construction equipment or materials placed thereon.

When forms are removed before the specified curing is completed, measures shall be taken to immediately continue curing. In cold weather conditions, adequate thermal protection for the concrete shall be provided.

03311.3.4 Embedments

Anchor bolts, castings, steel shapes, conduit, sleeves, masonry anchorages, and other materials embedded in the concrete shall be accurately positioned and securely anchored.

Location tolerances for anchor bolts, and for structural members, embedded structural steel shapes, and plates, shall be in accordance with AISC Manual of Steel Construction Code of Standard Practice.

Tolerances for equipment anchorages shall be as required by Article 03311.3.15.1.

Anchor bolts shall be provided with sufficient threads to permit a nut to be installed on each side of the form or template. The nuts shall secure the bolt in its proper position.

Pipe sleeves, conduit, and other embedments shall be within ½ inch of their design locations unless specified otherwise on the drawings or other specification sections.

Embedments shall not be welded to structural reinforcement.

Embedments shall be clean when they are installed. After concrete placement, exposed surfaces of embedments shall be cleaned of all concrete spatter and other foreign substances.

Anchor bolt sleeves, handrail sleeves, and similar openings in concrete susceptible to filling with water and freezing shall be filled with closed cell PVC expansion joint filler for protection until grouting. The upper neck of plastic anchor bolt sleeves shall be cut out and the annular space filled with closed cell PVC expansion joint filler or other means acceptable to the Engineer.

03311.3.4.1 Water Stops. Water stops shall be clean and free from coatings that weaken the bond with concrete. Each PVC water stop shall be continuous throughout the length of the joint. Intersections shall be made using factory prefabricated crosses, tees, and ells. The performance of the splice shall be equal to that of the continuous material and shall be made in strict conformance with the recommendations of the water stop manufacturer. Hydrophilic water stops shall be installed as recommended by the water stop manufacturer.

Water stops shall be maintained in proper position until the concrete has been deposited and compacted.

03311.3.5 Placement

The handling, depositing, and compacting of concrete shall conform to these specifications. Adjustments may be made by the Owner for weather or placement conditions.

The Contractor shall be notified at least 24 hours in advance of the times and locations where concrete is being placed.

Concrete shall not be pumped through aluminum or aluminum alloy pipe.

Construction joints indicated on the drawings shall define the limits of each concrete pour.

Subgrades shall be moistened with water prior to concrete placement. The subgrade shall not contain puddles or wet, soft, unstable or muddy areas when the concrete is placed.

Concrete placed against rock or existing concrete shall have loose pieces of rock removed and the exposed surface cleaned with a high-pressure hose before concrete is placed.

The space receiving concrete shall be clean and clear of debris and standing water, and the entire installation shall be acceptable to the Site Construction Manager before concrete is placed.

Surfaces encrusted with dried mortar or concrete from previous placement operations shall be cleaned before placing new concrete.

03311.3.5.1 Bonding to Hardened Concrete. The surface of hardened concrete, upon which fresh concrete is placed, shall be rough, clean, and damp. The hardened surface shall be cleaned of all laitance and foreign substances, shall be washed with clean water, and shall be in a saturated-surface-dry condition by soaking with potable water for 8 to 24 hours before the fresh concrete is placed. Excess water shall be removed from the surface receiving concrete prior to placement.

The surface of hardened concrete shall be prepared by one of the following methods:

At the time of the initial concrete placement, a retarding agent shall be applied to the fresh concrete. After hardening, the concrete shall be pressure washed to remove the laitance and to expose the aggregate.

The hardened concrete shall be roughened to approximately 1/4 inch amplitude. The concrete may be roughened at the time of the initial concrete placement or by mechanical means after the concrete has hardened. The roughened surface shall expose the aggregate and have an open pore structure.

The prepared surface shall receive one of the following surface bonding treatments:

A 2 inch thick mortar puddle shall be deposited on hardened concrete in wall and column forms immediately before placing fresh concrete. The mortar puddle shall be the specified concrete mix, at the same water content, with the coarse aggregate omitted.

An epoxy bonding adhesive shall be used. The epoxy bonding adhesive shall be installed in accordance with the manufacturer's instructions. Concrete shall be placed before the adhesive sets.

03311.3.5.2 Conveyance and Distribution. Concrete shall be conveyed to the placement location by methods that prevent separation or loss of the ingredients.

03311.3.5.3 Depositing Concrete. Concrete shall be deposited in horizontal layers. The depth of a layer shall not exceed 24 inches. Each layer of concrete shall be plastic when succeeding layers are placed. Concrete shall be deposited without moving it laterally in the forms for a distance exceeding 5 feet, unless otherwise accepted by the Owner.

Plastic concrete is defined as concrete that allows the head of an operating immersion type vibrator head to penetrate its full length into the previously placed concrete by means of its own weight.

Concrete that is no longer plastic shall be prepared as specified in Article 03311.3.5.1 and slushed with mortar puddle. Mortar puddle shall be the specified concrete mix with the coarse aggregate omitted. The preparation of the in-place concrete shall be acceptable to the Owner before the successive layer of concrete is placed.

03311.3.5.3.1 Not used

03311.3.5.4 Consolidation. Concrete shall be compacted using mechanical immersion type vibrating equipment. Mechanical vibrators shall maintain at least 9,000 cycles per minute when immersed in the concrete. Each vibrator shall be driven by a 1-1/2 hp (1 kW) or larger motor. The number and type of vibrators shall be acceptable to the Owner.

03311.3.5.5 Hot Weather Concreting. Hot weather concreting shall be in accordance with the recommendations of the codes and standards specified.

At air temperatures of 90° F and above, special procedures shall be used to keep the concrete as cool as possible during placement and curing.

03311.3.5.6 Cold Weather Concreting. Cold weather concreting shall comply with the codes and standards specified. 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 3 successive days, concrete shall meet the following minimum temperatures immediately after placement and shall be maintained at these temperatures throughout the curing period:

55° F for sections less than 12 inches in the least dimension.

50° F for sections 12 inches to 36 inches in the least dimension.

45° F for sections 36 inches to 72 inches in the least dimension.

40° F for sections greater than 72 inches in the least dimension.

Calcium chloride shall not be used.

Concrete shall not be placed on frozen ground. If the sub-grade is frozen, it shall be removed before concrete is placed.

If freezing weather is expected, the sub-grade receiving concrete shall be protected from freezing.

03311.3.5.7 Mass Concrete. Concrete for structures indicated on the drawings as mass concrete shall meet the following additional requirements. The temperature of concrete when deposited shall not exceed 70° F nor be less than 35° F, unless the Contractor submits an alternative placement plan for acceptance by the Owner.

The Contractor shall coordinate with the concrete supplier to meet the temperature requirements for the concrete at the delivery point.

The concrete shall be cooled gradually so that the drop in concrete surface temperature during and at the conclusion of the specified curing period does not exceed 20° F in any 24 hour period.

Concrete placed in cold weather shall meet the requirements for cold weather placement.

03311.3.6 Joints

03311.3.6.1 Construction Joints. Construction joints shall be located and constructed as indicated on the drawings. If an alternative arrangement of construction joints is desired or if they are not located on the drawings, drawings locating and detailing the proposed joints shall be submitted to the Owner before detailing and fabricating reinforcing steel. These joints shall be installed only where acceptable to the Owner.

All construction joints subjected to differential hydrostatic pressure shall be provided with a water stop. Water stops shall be furnished in other joints as indicated on the drawings.

03311.3.6.2 Movement Joints. Movement joints may be expansion, contraction, or isolation joints. These joints shall be located and constructed as indicated on the drawings. Expansion joint filler shall be firmly bonded to the previously placed joint face with a suitable adhesive. The new concrete shall be poured directly against the joint filler. Accessible edges of each joint shall be sealed with polyurethane sealant.

Movement joints shall be as detailed on the drawings.

Joints indicated on the drawings and those subjected to differential hydrostatic pressure shall be provided with a water stop installed as indicated on the drawings.

03311.3.6.3 Slab Control Joints. If sawed control joints are used, sawed joints shall be 1/8 inch to 5/32 inch wide with a minimum depth of one fourth of the slab thickness but not less than 1 inch. Reinforcement shall not be cut during joint sawing. These joints shall be located as indicated on the drawings. Cutting shall begin as soon as the concrete has hardened sufficiently to prevent dislodging aggregate. Sawing shall be completed within 12 hours of completing placement.

03311.3.7 Openings in Concrete

Concrete wall and floor openings for piping and other fixtures, installed after the walls and floors are built, shall allow sufficient space to properly compact concrete to fill the space around the pipe or fixture. The top of each wall opening shall be sloped or beveled to provide adequate space for placing and compacting the pipe embedment concrete. Water stops shall be provided around wall openings below grade and floor openings that are exposed to weather or submergence.

03311.3.8 Finishing Formed Surfaces

The standard finish shall be a rough form finish. Fins and other surface projections exceeding 1/4 inch (6 mm) shall be removed from all formed surfaces except exterior surfaces that will be covered with earth backfill. Surface finish shall be that imparted by the forms.

03311.3.9 Finishing Unformed Surfaces

No surface treatment will be required for buried or permanently submerged concrete. Unformed surfaces, designated as screeded surfaces on the drawings, shall be finished by screeding only. Surfaces designated as floated surfaces and all surfaces not otherwise designated shall be finished by screeding and floating. Surfaces designated as troweled surfaces shall be finished by screeding, floating, and troweling.

Float finished and screeded surfaces shall be finished to provide a flat profile within 1/8 inch deviation as measured from a 10 foot straightedge. Trowel finished surfaces shall be finished to form a flat plane. The surface profile shall not deviate more than 1/8 inch when measured from a 10 foot straightedge.

03311.3.9.1 Screeding. Screeding shall provide a concrete surface conforming to the designated elevations and contours with all aggregates completely embedded in adjacent mortar. Surface irregularities in screeded surfaces shall be limited to the tolerances specified.

03311.3.9.2 Floating. The surfaces shall be screeded and given an initial float finish as soon as the concrete has stiffened sufficiently to work. Coarse aggregate disturbed by the float or causing a surface irregularity shall be removed and replaced with mortar. Initial floating shall produce a surface of uniform texture and appearance.

Initial floating shall be followed by a second floating at the time of initial set. The second floating shall produce a smooth float finish of uniform texture and color.

Floating shall be performed with hand floats or suitable mechanical compactor floats.

03311.3.9.3 Troweling. Surfaces designated on the drawings shall receive a steel trowel finish. Troweling shall be performed after the second floating when the surface has hardened sufficiently to prevent excess cement from being drawn to the surface. Troweling shall produce a dense, smooth, uniform surface free from blemishes and trowel marks.

03311.3.9.4 Brooming. Brooming shall follow the float finish for surfaces so designated on the drawings. Brooming shall be done with an acceptable steel or fiber broom not less than 18 inches wide. Adjacent strokes of the broom shall overlap slightly. Broomed surfaces shall be free of porous spots, irregularities, depressions, and small pockets or rough spots.

03311.3.9.5 Aggregate Exposure. Surface mortar shall be removed and the aggregate exposed from surfaces that will be covered with mortar, concrete, or grout at a later time. The method used shall be effective and acceptable to the Owner.

03311.3.9.6 Edging. Unless specified to be beveled, exposed edges of floated or troweled surfaces shall be edged with a tool having a 1/4 inch corner radius.

03311.3.9.7 Finishing Mortar. Finishing mortar shall be added if there is not sufficient mortar available from the concrete mix. The proportions for this finishing mortar shall be 2.4 parts of concrete sand to one part of Portland cement, by weight, mixed with enough water for proper application. Slump for finishing mortar shall not exceed 2 inches.

03311.3.10 Separate Finishes

Certain slab surfaces shall be finished with a separate concrete finish or floor covering as indicated on the drawings.

Base slab surfaces shall be ground or filled until each surface is within the specified tolerances and is acceptable to the Owner. Low areas shall be filled. High spots shall be ground slightly lower than required and then filled and smoothed to the proper elevation and surface.

Surfaces that receive epoxy set quarry tile and resilient tile shall be flat with a profile that shall not deviate more than 1/8 inch from a 10 foot straightedge placed on any part of the surface. These surfaces shall be either trowel finished concrete at the elevation indicated on the drawings or a float finished surface set 1/8 inch (3 mm) low and leveled with trowel finished fill material.

Surfaces that receive a mortar set quarry tile, ceramic tile, or terrazzo finish shall be given a smooth, tight, and uniform float finish with a profile tolerance of 1/4 inch as measured from a 10 foot straightedge.

03311.3.11 Curing

Concrete shall be protected from loss of moisture for not less than 7 days after the concrete is placed.

Troweled surfaces, except those that receive a separate finish or coating, shall be cured with a membrane curing compound. Float finished surfaces, except those that receive a separate finish, may be cured with either a membrane curing compound or with water. Only water curing shall be used if the surface receives a separate finish unless the curing compound is compatible with the surface finish that will be installed.

03311.3.11.1 Water Curing. Water saturation of concrete surfaces shall begin as quickly as possible after initial set of the concrete, but not more than 30 minutes. The rate of water application shall be regulated to provide complete surface coverage with a minimum of runoff. The concrete surface shall not be permitted to dry.

Water retaining structures shall be water cured.

03311.3.11.2 Membrane Curing. Membrane curing compound shall be applied within 30 minutes after final finishing of the surface or as soon as possible after finishing without causing damage to the surface. Membrane curing compound shall be spray applied at a coverage rate recommended by the compound manufacturer. A dissipating curing membrane may be used in lieu of wet curing on surfaces that will be covered at a later date with mortar, concrete, damp-proofing, tile, or coating.

03311.3.12 Floor Sealer

Where indicated on the drawings, concrete floors shall be given a coat of clear floor sealer in addition to that applied as membrane curing compound. The coating shall be applied at the end of the curing period before any traffic is permitted on the floor. A second coat, if required, shall be applied after the floor has been cleaned in preparation for the final inspection. Floor sealer shall be applied in strict accordance with the manufacturer's recommendations.

03311.3.13 Repairing Defective Concrete

Surface defects in formed concrete shall be repaired to the satisfaction of the Owner. Concrete that is porous, honeycombed, or otherwise defective to a depth in excess of 1 inch shall be cut out and removed to sound concrete. Edges shall be square cut to avoid feathering. Bonding surfaces shall have the laitance removed and the coarse aggregate exposed. A bonding compound shall be used between the hardened and repair concrete profile. When epoxy bonding adhesive is used, surfaces shall be prepared and the compound applied as recommended by the bonding agent manufacturer. Defective concrete shall be replaced within 48 hours after the forms have been removed.

Concrete repair work shall not interfere with the curing of surrounding concrete. Mortar and concrete used in repair work shall be adequately cured and shall be finished to match adjacent surfaces.

03311.3.14 Duct Banks

Reinforcing steel and other magnetic materials installed in duct banks shall be parallel to the lengths of the ducts unless they enclose all the ducts of the duct bank.

Hardened surfaces that receive additional concrete shall have the surface prepared in accordance with Article 03311.3.5.1. The surface shall be thoroughly wetted and a thin coating of cement mortar shall be spread over the surface before concrete is placed.

Duct bank concrete shall be carefully compacted to avoid damaging the conduit. Concrete shall be worked around reinforcements and embedments and into the corners of the forms.

Red dye shall be applied to the top concrete surface.

03311.3.15 Tolerances

Tolerances shall be in accordance with ACI 117. Tank foundations shall also be in accordance with API 650. The offset between adjacent pieces of formwork facing material for surfaces exposed to view shall not exceed 1/2 inch and for concealed surfaces shall not exceed 1 inch. Embedments shall meet the tolerances of Article 03311.3.4.

03311.3.15.1 Substation and Equipment Bases. Concrete bases and their embedments for structures and equipment shall meet the following tolerance requirements in addition to those already specified, unless otherwise specified by the equipment supplier.

Concrete form dimensions and placement shall be within 1/2 inch of the dimensions and locations indicated on the drawings. The top of the forms shall be accurately set to the designated elevation and within the specified tolerances.

The elevation of all points on all float finished surfaces shall be within 1/4 inch of the elevation indicated on the drawings. The elevation of all points on all trowel finished surfaces shall be within 1/8 inch of the elevation indicated on the drawings.

Anchor bolts and all other materials that are embedded in the concrete shall be accurately positioned and securely anchored. The center of each anchor bolt group or cluster shall be within 1/8 inch of the location indicated on the drawings. The center-to-center dimensions between the anchor bolts in a group or cluster shall be within 1/16 inch of the dimensions indicated on the drawings.

03311.3.16 Special Structures

Special structures may sustain severe service conditions. These structures require very close tolerances and clearances. If required, special structures covered by these specifications are listed in Article 03311.1.3.

Work for these structures shall meet the following requirements in addition to those specified elsewhere.

03311.3.16.1 Forms. Forms shall be designed by a Licensed Engineer experienced in this work. The forms shall be designed and constructed to a tolerance of 1/4 inch from the locations and elevations indicated on the drawings. The form design shall provide for supporting the weight of the reinforcing bars and all construction loads. The drawings and calculations for elevated portion of the special structure to be signed and sealed by a Licensed Engineer.

03311.3.16.2 Reinforcing Steel. Longitudinal reinforcing bars in beams and girders shall be supported by mild steel angle or channel frames resting on the bottom form. Each bar shall be securely attached to its supporting frames by a mechanical anchor. A steel bearing plate shall be provided on each upright frame for distributing the frame load over the surface of the bottom form. Bearing plates shall be flat and smooth.

03311.3.16.3 Anchor Bolts and Templates. Anchor bolts and attachments shall be located to the tolerances required by the equipment manufacturer for the equipment secured, and shall be secured during concrete placement with accurately made steel templates. Templates shall be interconnected and braced with steel members that maintain the anchor bolt alignment and position.

Alignment of forms, reinforcements, embedments, and anchor bolts shall be checked before placing concrete.

03311.3.16.4 Concreting Plan and Construction Operations. A detailed concrete placement plan shall be prepared. The plan shall describe the methods, labor, and equipment used in conveying, depositing,

consolidating, and curing the concrete. The plan shall indicate the number, production rates, and deployment of each piece of equipment and each crew of workers. The plan shall provide adequate margins for uncertainty in productivity and adequate backup for breakdown of equipment. In determining the required production rates, the advancing faces of fresh concrete shall be assumed to have a slope of 4 to 1.

03311.3.17 Field Control Testing

When testing is specified to be conducted by the Contractor, tests shall be conducted in accordance with the following.

03311.3.17.1 Sampling. Field control tests shall be made at the point of placement in the presence of the Owner. Equipment, supplies, and qualified personnel necessary for the field control testing shall be supplied.

Tests shall be performed under the Scope of Work of this contract. The Contractor shall utilizing Ellis and Associates, Inc to perform the testing. The frequency specified for each field control test is a minimum. Additional field control tests shall be made if requested by the Owner.

03311.3.17.2 Slump. A slump test shall be made from each of the first three batches mixed each day. An additional slump test shall be made for each additional 50 cubic yards of concrete placed that day.

When plasticizers and super-plasticizers are added at the site, the slump shall be measured and recorded before and after the addition.

03311.3.17.3 Air Content. An air content test shall be made from one of the first three batches mixed each day and from each batch of concrete used to make compression test cylinders.

03311.3.17.4 Concrete Temperature. A concrete temperature test shall be made from one of the first three batches mixed each day and from each batch of concrete used to make compression test cylinders.

03311.3.17.5 Compression Tests. Concrete compression test cylinders shall be made each day concrete is placed. A set of five test cylinders shall be made from the same batch at 150 yd³ intervals required by the referenced standard in Article 03311.1.4 unless alternate intervals are specified by the Engineer.

Each set of compression test cylinders shall be marked or tagged with the date and time of day the cylinders were made, the location in the work where the concrete represented by the cylinders was placed, the delivery truck or batch number, the air content, and the slump.

For each set of cylinders, one cylinder shall be tested at an age of 7 days, two cylinders shall be tested at an age of 28 days, and two cylinders shall be stored until otherwise directed by the Construction Manager or Engineer.

03311.3.17.6 Test Reports. Test reports shall contain the information specified by ASTM C39 and the following additional information:

Date, time, and ambient temperature of pour.

Location of pour.

Mix class.

All test reports shall be kept by the Contractor and submitted to the Owner. All copies of failed tests shall be submitted to the Engineer.

03611 - Grouting

03611.1 General

03611.1.1 Scope of Supply

Scope of supply shall include surface preparation, grout materials, placement, and curing of grout placed under base plates and soleplates for equipment and structures.

03611.1.2 Not Used

03611.1.3 Performance and Design Requirements

Unless otherwise specified below, performance and design requirements for the grouting are indicated in Article 03611.1.5.

03611.1.4 Codes and Standards

Work performed under these specifications shall be done in accordance with the following codes and standards. Unless otherwise specified, the applicable governing edition and addenda to be used for all references to codes or standards specified herein shall be interpreted to be the jurisdictionally approved edition and addenda. If a code or standard is not jurisdictionally mandated, then the current edition and addenda in effect at the date of this document shall apply. These references shall govern the work except where they conflict with the Owner's specifications. In case of conflict, the latter shall govern to the extent of such difference:

Work	In Accordance With
Grout mixing and placing	Manufacturer's instructions

03611.1.5 Materials

The following materials shall be used:

General	
Grouting	Application
General purpose non-shrinking cementitious grout	Structural columns, tank bases, stationary equipment, and pumps and compressors up to 25 hp Grout shall meet ASTM C1107 and the following additional requirements within the temperature range of 50° F (10° C) and 90° F (32° C). Compressive strength shall be a minimum of 5000

03611.1.6 Approved Manufacturers of Components

For the following components, only the listed manufacturers are recognized as maintaining the level of quality of product and field support services required by these specifications. If the Contractor wants to propose a non-listed manufacturer that is considered to provide an equivalent level of quality, this manufacturer must be identified and supporting data provided. Acceptance of the manufacturer as a substitute is at the discretion of the Engineer:

Component	Manufacturer
General purpose non-shrinking cementitious grout	Master Builders "Set Grout" L & M "Duragrout" Conspec "Enduro 50 Grout" Unisorb "V-2" Euclid "Euco N-S"

03611.1.7 Test Requirements

The following testing for cement grouts shall be conducted in accordance with the specified standards listed in the following table. Strength shall meet the requirements of ASTM C1107. This testing is to be considered part of the defined Scope of Work, and all associated costs are the responsibility of the Contractor. Field testing of the grout shall be performed as follows:

Field Flow Cone Testing

Field flow cone tests shall be performed as specified below to establish the water content that will meet the fluid consistency performance for the grout. The maximum and minimum water content shall be established to confirm the fluid consistency will meet the specified grout strength. Grout cubes shall be made and tested from the same batch that the flow cone measurements are taken at the upper and lower water content range being established for the placement.

Contractor may propose a method to establish the water content limits for the fluid consistency as a substitute for the flow cone tests, if acceptable to the Engineer. Adequate documentation shall be provided to substantiate the reliability for this substitute procedure:

Flow cone testing shall be performed at the following frequency:

Prior to the first grouting operation as directed by the Owner.

Each new lot of grout material.

Compression testing shall be performed at the following frequency:

A minimum of one compression test for each individual placement operation each grouting day, if less than 5 cubic feet.

One compression test for each additional 5 cubic feet or fraction thereof, for each individual placement operation.

Tests	In Accordance With	Conducted By
Field flow cone (20 to 30 seconds reading)	ASTM C939	Contractor utilizing Ellis and Associates, Inc to perform the testing
Field compression test cubes (three 2 inch cubes)	ASTM C109 as modified by ASTM C1107	Contractor utilizing Ellis and Associates, Inc to perform the testing

03611.1.8 Technical Attachments

Technical attachments relevant to the work under this section are listed in Section 01100.

03611.1.9 Supplemental Specifications

Technical supplemental specifications that are applicable to the work covered under this technical specification section are identified and included in Section 01400.

03611.2 Products

The product shall be as specified in Article 03611.1.5.

03611.3 Execution

03611.3.1 Baseplate Grouting

Base plates shall be grouted in place to obtain a uniform and solid bearing surface. Grouting methods used shall provide complete, void free filling of all space beneath the base plate. Alignment or level of base plates shall not be disturbed during grouting procedures.

All anchor bolt sleeves shall have closed cell foam and excess water removed prior to grouting operations.

03611.3.2 Surface Preparation

Hardened concrete surfaces where grout is to be placed shall be mechanically prepared by chipping or sandblasting to remove laitance, to expose sound surface mortar, and to provide a fractured aggregate surface. Prepared surfaces shall be cleaned to remove oil, grease, curing compound, or other foreign materials that prevent a proper bond between grout and concrete. The prepared surface shall be flooded with potable water for 8 to 24 hours prior to grout placement. The surface shall be wet without standing water or puddles immediately prior to grout placement. If compressed air is used to blow off excess water, the air compressor shall have an oil separator.

Prepared surfaces shall be in accordance with the grout manufacturer's recommendations.

03611.3.3 Alignment and Leveling

Base plates shall be set in place over anchor bolts, properly aligned, and leveled using three-point control. Leveling shall be accomplished using leveling screws with nuts above and below temporary lugs attached to the base.

Steel wedges may be used for leveling in lieu of leveling screws. Precautions shall be taken to prevent steel wedges from being dislodged during grout placement. Steel wedges shall be encapsulated by a minimum of 2 inches of grout.

Wood blocking or wood wedges shall not be used.

Steel wedges used with cementitious non-shrinking grout may remain in place but must be completely covered with the grout.

03611.3.4 Mixing

Grout shall be mixed as recommended by the grout manufacturer.

03611.3.5 Placement

Proper alignment and level shall be verified and accepted by the Site Construction Manager before placing grout. Grout shall be used immediately after mixing before stiffening occurs. The temperature of the grout at placement shall not exceed the manufacturer's recommendations. Placement methods used shall provide grout surfaces that are completely filled, without voids.

Low dams enclosing the base shall be used to contain flowable grout mixtures. Adequate space shall be provided between the dam and base to permit pouring and manipulation of the grout. The top of the dam shall be higher than the bottom of the base. The space below the base shall be completely filled. All air and water pockets shall be eliminated to create a solid grout mass without voids.

03611.3.6 Cementitious Grout

03611.3.6.1 Finishing. Grout shall remain undisturbed after placing until a stiff set is obtained. The dam shall be removed, and the edges shall be finished by removing excess grout. The edges shall be beveled at an angle of approximately 45 degrees. Exposed edges of the foundation and adjacent surfaces shall be cleaned to remove all grout.

03611.3.6.2 Curing. When finishing is completed, wet curing shall be provided by applying liberal amounts of potable water for a minimum of 24 hours unless required otherwise by the grout manufacturer's instructions. Following wet curing, curing compound acceptable to the Engineer may be applied to all exposed surfaces as an alternative to continued wet curing. During wet curing, a covering of wet rags and polyethylene sheets may be used to maintain the grout in a wet environment for the period of time required by the manufacturer's standards. The grout shall not be allowed to freeze during the curing period.

Special procedures shall be used to keep the grout cool when air temperatures of 90° F (32° C) or higher are encountered.

05500 – Miscellaneous Metals

05500.1 General

05500.1.1 Scope of Work

Work under these specifications shall include erecting miscellaneous metals and services complete as specified herein:

Scope of Supply (Procurement)
Development of Detail Design Drawings
Detailing and production of fabrication and erection drawings.
Material procurement, fabrication, surface preparation, coating application and shipping in accordance with these specifications and the drawings.
Scope of Supply (Erection)
Receipt, inspection, unloading, storage and erection of materials furnished under these specifications or furnished by others, in accordance with the specifications and the drawings.
Preparation of galvanized slip-critical connection faying surfaces.
Supply and install touchup coatings.

05500.1.1.1 Miscellaneous Materials and Services for Procurement. Miscellaneous materials and services not otherwise specifically called for shall be furnished by the Contractor in accordance with the following:

Tests and inspections required by the specifications.

Document submittals as specified in Technical Supplemental Q500.

05500.1.1.2 Miscellaneous Materials and Services for Erection. Miscellaneous materials and services not otherwise specifically called for shall be furnished by the Contractor in accordance with the following:

Supply all fit-up bolts, welding electrodes, welding, and other fasteners that are necessary for the completion of the work.

Survey and lay out the work from the designated control points.

Tests and inspections required by the specifications.

Document submittals as specified in Technical Supplemental Q500.

05500.1.2 Not Used

05500.1.3 Codes and Standards

Work performed under these specifications shall be done in accordance with the following codes and standards. Unless otherwise specified, the applicable governing edition and addenda to be used for all references to codes or standards specified herein shall be interpreted to be the jurisdictionally approved edition and addenda. If a code or standard is not jurisdictionally mandated, then the current edition and

addenda in effect at the date of this document shall apply. These references shall govern the work except where they conflict with the Owner's specifications. In case of conflict, the latter shall govern to the extent of such difference:

Work	In Accordance With
Structural steel	AISC Steel Construction Manual, Fourteenth Edition
Structural steel	AISC Specification for Structural Steel Buildings, AISC 360-10, with Commentary and Supplements; ISC Seismic Provisions for Structural Steel Buildings, 341-10, with Commentary and Supplements AISC Code of Standard Practice for Steel Buildings and Bridges, AISC 303-05
Structural steel	AISC Specification for Structural Steel Buildings, AISC 360-10
Structural steel	AISC Quality Certification Program for Structural Steel Fabricators
Structural steel	ASTM A6/A6M
Bar grating	ANSI/NAAMM MBG 531
Heavy-duty bar grating	ANSI/NAAMM MBG 532
Checkered steel floor plate	ASTM A786/A786M
Steel for banding of panel ends and kickplates	ASTM A36/A36M, ASTM A1011/A1011M, or acceptable equal
Welding	ANSI/AWS D1.1 Structural Welding Code – Steel
Coatings	SSPC Paint Application Specification No. 1, "Shop, Field and Maintenance Painting"

05500.1.4 Materials

The following materials shall be used:

Component	Material
Structural steel wide flange and WT shapes	ASTM A588/A588M, Grade 50
Structural steel channels	ASTM A588/A588M, Grade 50
Structural steel S shapes	ASTM A588/A588M, Grade 50
Structural steel angles and plates	ASTM A588/A588M, Grade 50
Structural steel baseplates and plate over 4 in thick	ASTM A588/A588M, Grade 42
Structural steel shim plates and fill plates	Material to match parent steel material

Component	Material
Structural tubes	ASTM A500, Grade B
Steel pipes	ASTM A53, Type E or S, Grade B
Welding electrodes	Low hydrogen types, with a minimum tensile strength = 70,000 psi (495 MPa)
Shear connectors for composite construction	FabriSteel Nelson Stud Welding Headed Stud or Hilti X-HVB Shear Connector or acceptable equal
Anchor rods (anchor bolts)	ASTM F1554 Grades 36, 55, and 105 with nuts conforming to ASTM A563, Grade A heavy hexagon.
Anchor rod sleeves	ASTM A53 standard weight pipe or ASTM A36 plate or plastic sleeves
Post-installed mechanical anchors	Federal Specification A-A-1923A, Type 4; ACI 318, Appendix D; IBC compliant; and tested to ICC AC-193 with corresponding ICC ESR report Hilti Kwik-Bolt TZ Expansion Anchor (ICC ESR-1917 report)
Post-installed adhesive anchors	IBC compliant and tested to ICC AC-308 with corresponding ICC ESR report Adhesives: Hilti HIT RE 500-SD (ICC ESR-2322 report) Anchors: Hilti HAS Standard Rods (A36) Hilti HAS Super Rods (A193 B7) Hilti HIT-TZ Rods
Threaded inserts for concrete	Hilti HIS and HIS-R Internally Threaded Inserts with HIT RE 500-SD Adhesive
Continuous inserts for concrete	Unistrut P3200 Series, hot-dip galvanized with P3712P inserts installed to prevent concrete seepage
Lifting lugs for concrete	Dayton/Richmond Utility Anchor Lifting System. Lugs designed for safe working loads
Checkered steel floor plates	ASTM A786/A786M
Ladders	ASTM A36/A36M

05500.1.5 Additional Requirements

Additional requirements for the materials and coatings to be furnished under this section of these specifications are indicated herein:

Component	Material
Connection Requirements	Shop welded, field bolted or Shop and field bolted
Bolting Requirements	
Slip-critical connection scope	All connections with oversized or long-slotted holes in one or more plies, except as noted on the drawings
Pretensioned connection scope	All structural connections not required to be slip-critical
Snug-tightened connection scope	Connections to non-structural steel components
Control of bolt tension	Turn-of-nut
Coating Requirements	
Embedded structural steel shapes and plates, threaded inserts, continuous inserts	Hot-dip galvanized.
Anchor rods	Hot-dip galvanized.
Structural steel shapes, plates, tubes and pipes – exterior location	Hot-dip galvanized.
Structural steel shapes, plates, tubes and pipes - interior location	Hot-dip galvanized.
Ladders – exterior location	Hot-dip galvanized.
Ladders - interior location	Hot-dip galvanized.
Shear connectors	Galvanized
Post-installed anchors	Galvanized
High strength bolts, nuts, and washers	Mechanically galvanized per ASTM B695 Class 50 (A325 and F1852 only). All connection components shall receive the same coating. When bolts are galvanized, washers and nuts shall be <u>mechanically</u> galvanized.
Rectangular bar grating	Hot-dip galvanized
Heavy-duty rectangular bar grating	Hot-dip galvanized
Checkered steel floor plates	Hot-dip galvanized
Additional Coating Requirements	

Component	Material
Shop or Field touchup	Hot dip galvanized touchup shall be in accordance with Q320

05500.1.6 Approved Manufacturers of Components

For the following components, the manufacturers identified in Article 05500.1.4 or listed below provide examples of the quality of workmanship required by these specifications. If the Contractor wants to propose a nonlisted manufacturer that is considered to provide an equivalent level of quality, this manufacturer must be identified and supporting testimony provided. Acceptance of the manufacturer as a substitute is at the discretion of the Engineer:

Component	Manufacturer
High strength bolts	Approved US Supplier
Direct tension indicators (DTIs). DTIs using a silicon gel marker to indicate full-tension are not acceptable.	TurnaSure LLC
Plastic anchor rod sleeves	Sinco Anchor Bolt Sleeve as distributed by Sinco/Sala Products, Inc.
Rectangular metal bar grating and stair treads and heavy-duty bar grating	AMICO Klemp or IKG Industries
Checkered steel floor plate	AMICO Klemp or IKG Industries

05500.1.7 Test Requirements

The following testing shall be conducted in accordance with the specified source. This testing is to be considered part of the defined Scope of Work, and all associated costs are the responsibility of the Contractor:

Tests	In Accordance With	Conducted By
Nondestructive Testing of Welds	Technical Supplemental Specifications Q100 and Q121 included in Section 01400	Contractor
Testing of High Strength Bolts by Bolt Manufacturer, ASTM A325, A490 and F1852	ASTM A325, ASTM A490 and ASTM F1852, Production Lot Method	Manufacturer
Testing of Direct Tension Indicators	ASTM F959, Article 10.2, Production Lot Method	Manufacturer

05500.1.8 Technical Attachments

Technical attachments relevant to the work under this section are listed in Section 01100.

05500.1.9 Supplemental Specifications

Technical supplemental specifications that are applicable to the work covered under this technical specification section are identified and included in Section 01400.

05500.2 Products

05500.2.1 Drawing Requirements

Contractor-produced drawings shall be in accordance with Technical Supplemental Q500 and the following requirements.

Each drawing submitted shall indicate the name of the project, the unit designation, the contract title, the contract number, the name of the building structure, and the Contractor's name. In addition, the Owner's identification number will be affixed by the Engineer to each Contractor's initially submitted shop drawing. This number shall be maintained on all subsequent submittals of the drawings in the identical format and location as originally indicated by the Engineer.

Erection drawings shall be submitted with, or prior to, the submittal of the corresponding detail drawings.

A field bolt list indicating the number and length of each bolt shall be submitted.

Details of the proposed typical beam connections shall be submitted with the first package of drawings.

Each detail drawing shall include a Bill of Material. The total weight, area, or length of material on each sheet in every represented unit price category listed in the Proposal section shall be listed on every detail drawing.

Each detail drawing shall indicate the mark number of each fabricated piece as assigned by the Contractor and list any material identification numbers assigned by the Engineer.

Detail drawings shall indicate the top elevation of all horizontal members.

05500.2.2 Materials

Materials shall be new and unused and shall conform to the following.

05500.2.2.1 Steel Certification. Signed chemical-composition and mechanical-property mill certifications shall be obtained for all steel purchased under this specification. If requested, a copy of the mill certifications shall be provided to the Engineer in accordance with Technical Supplemental Q500.

05500.2.2.2 Bolt Inspection - Manufacturer. High strength bolts shall be tested by the manufacturer prior to shipment in accordance with the Production Lot Method. If requested, a copy of the inspection test reports shall be forwarded to the Engineer in accordance with Technical Supplemental Q500.

The Engineer reserves the right to independently test the bolt materials. Should the bolt materials be found to be defective, they shall be replaced at the Contractor's expense.

05500.2.2.3 Direct Tension Indicators (DTIs) - Manufacturer. DTIs shall be inspection tested by the manufacturer prior to shipment in accordance with the Production Lot Method described in ASTM F959, Article 10.2. If requested, a copy of the inspection test reports shall be forwarded to the Engineer in accordance with Technical Supplemental Q500.

The Owner reserves the right to independently test the DTIs. Should the DTIs be found to be defective, they shall be replaced at the Contractor's expense.

05500.2.3 Structural Steel Fabrication

Structural steel shall be fabricated to the dimensions, arrangements, sizes and weights, or thicknesses indicated on the drawings or required by these specifications.

Embedded materials shall be accurately fabricated and assembled. Warped or bent sections, which do not fit into the concrete forms as required, shall be replaced with suitable materials.

Structural steel shall be fabricated to tolerances that will permit field erection within AISC tolerances, except that the displacement of any column center line from the established column line shall not be more than 1 inch at any point in the total height of the column.

Cuts, copes, and holes shall be clean cut without torn, ragged edges or burrs.

Unnecessary bolt holes in structural steel materials less than 1-1/2 inches (38 mm) in thickness shall be filled with weld metal and ground smooth. These repairs shall be made before preparing the member for shop painting or galvanizing. Unnecessary bolt holes in structural steel material 1-1/2 inches or greater in thickness shall be plugged with high strength bolts.

The radius of beam copes and weld access holes shall be provided free of notches and shall be in accordance with AWS D1.1. Repair of notches shall be in accordance with AWS D1.1.

The locations and details of all welded splices in structural members or components shall be acceptable to the Engineer. Unauthorized splices are not allowed. Splices will not be permitted in areas of high stress. The Engineer's acceptance of splice locations shall be obtained before fabrication.

Holes and other provisions for field connections shall fit when the units are assembled in the field. Where required by the drawings or by the necessity of proper identification and fitting of field connections, the connections shall be matchmarked.

05500.2.4 Bar Grating Fabrication

Grinding of crossbar ends is not required if the spacer bars project no more than 1/8 inch (3 mm) beyond the outside bearing bars and the overall panel width used in laying out the work is adjusted to allow for extensions.

Kickplates shall be provided where indicated on the drawings.

Where openings are indicated in gratings, such as for the passage of pipes, grating sections shall be laid out so that each opening will be centered on a joint between sections. All openings shall be provided with a kickplate of formed steel plate or standard weight steel pipe welded to the bearing bars.

All kickplates shall extend the full depth of the grating.

Grating fasteners shall be supplied in accordance with Article 05500.1.4. The quantity of fasteners to be supplied shall allow each section of rectangular bar grating to be fastened in place with not less than two fasteners at each support plus a 2 percent overage.

When saddle-clips are supplied, welded stud type bolts including nuts and washers shall be included. Saddle-clips shall be galvanized and as specified in the NAAMM manual. Studs shall be Nelson Stud Welding, Erico Products Blue Arc, KSM Welding Systems, or acceptable equal. Welded stud type bolts shall be size 1/4-20 with pitch diameter base. Stud length after welding shall be approximately 1/8 inch (3 mm) less than the grating depth. Nuts shall conform to ANSI B18.2.2. Studs, washers, and nuts shall be zinc plated in accordance with ASTM B633, service condition SC4.

When the Hilti Grating Disk System is used, disks shall be either electro-galvanized Type X-FCM or hot-dip galvanized Type X-FCM-F and carbon steel threaded studs shall be electro-galvanized Type EM8-15-14FP10. Grating disks shall be sized according to height of grating.

05500.2.5 Bolted Connections

Bolt holes shall be standard size, nominally 1/16 inch (1.6 mm) larger than the nominal bolt diameter unless noted otherwise. Bolt holes in clip angle connections shall be short slotted perpendicular to the length of the angle unless otherwise noted. Holes in gusset plates shall be oversized unless otherwise noted. In the event oversized holes are used in an outer ply, hardened washers shall be installed over the oversized hole. Where long-slotted holes are used in an outer ply, plate washers shall be provided and installed over the long-slotted hole.

Contact surfaces of slip-critical connections coated with organic or inorganic zinc are acceptable, provided that the requirements for the specified AISC surface condition (Class A or Class B) are met.

All bolts shall be furnished with lubricated nuts. Hardened washers (flat and beveled) shall be furnished in accordance with the recommendations on the Research Council's Specification for Structural Joints.

05500.2.6 Welding

Welding of structural steel shall be in accordance with the requirements specified in Technical Supplementals Q100 and Q121 included in Section 01400.

All welds shall receive 100 percent visual inspection. Butt joint splices, complete penetration T-joints, plate girder welds, and built-up column welds shall be tested as described in Technical Supplemental Q121.

05500.2.7 Coatings

Coatings shall be in accordance with the Coating System Data Sheets. Shop paint shall not be applied within 3 inches (80 mm) of any field welded connection.

When galvanizing is specified for structural steel members, all connection components shall be galvanized.

05500.3 Execution

05500.3.1 General

Structural steel and miscellaneous metals shall be erected in a safe and workmanlike manner. Erection shall be in accordance with the requirements of OSHA Standard 29 CFR Part 1926, Subpart R, Steel Erection.

The Contractor shall store the miscellaneous metals in a manner that will prevent the materials from being damaged or subject to deterioration prior to erection. Materials shall not be stored in direct contact with the earth. Care shall be exercised to prevent damage of the steel coatings, and to prevent ponding of water that could damage the surfaces of galvanized materials.

Fasteners shall be furnished in suitable containers, which shall remain closed until the fasteners are required for erection.

Metals to be placed in concrete shall be installed as specified in Section 03311 and located as indicated on the drawings to the tolerances specified in Section 03311 and on the drawings.

05500.3.2 Steel Erection

All materials erected under this specification shall be erected in accordance with the specified standards, the design drawings, the erection drawings, and these specifications.

Shop and field beam connections shall conform to details indicated on the drawings.

When a Class A/C Hand Brushed Galvanized surface condition is specified, the faying surfaces of the slip-critical connections shall be roughened by means of hand wire brushing. Power wire brushing shall not be permitted.

Full pretensioning of high strength bolts shall be required at all slip-critical and pretensioned connections, and where noted on the drawings.

Bolts and bolting components shall be protected from dirt and moisture in closed containers at the site of installation. Only as many fastener components as are anticipated to be installed during the work shift shall be taken from protected storage. Fastener components that are not incorporated into the work shall be returned to protected storage at the end of the shift.

The length of high strength bolts installed in field connections will be determined in accordance with the Research Council's Specification for Structural Joints. The Contractor shall exercise care in following the field bolt list so as to eliminate the need for additional "long" bolts. Additional "long" bolts shall be provided only at the Contractor's expense.

After steel erection, all lifting lugs used for erection purposes shall be removed and the area around the lug ground smooth and flush with the adjacent area.

Open holes due to mismatched connections shall be filled with machine bolts and nuts or by welding. Welding shall be ground smooth.

05500.3.2.1 Bolting. The condition of the contact surfaces of each slip-critical type connection shall be in accordance with the slip-critical connection class requirements specified in the technical requirements. Prior to erecting the steel, the contact surfaces shall be inspected for compliance with the requirements given in the referenced edition of the Research Council's Specification for Structural Joints.

Contact surfaces at bearing type field connections may be painted or galvanized, but shall be free of foreign substances.

Connections requiring bolts of higher strength than ASTM A325 shall be examined after assembly to verify that the proper strength bolts have been installed.

Tightening of bolts shall be controlled using the method indicated in Article 05500.1.5. The work shall be done by competent and experienced bolting crews.

Bolted connections shall be drifted to proper position and the holes inspected to ensure that bolt threads will not be damaged by forcing the bolts in place. Connections shall be tightly drawn together using not less than 25 percent of the total number of bolts in the completed joints, but never less than two bolts. Bolts for initial tightening shall be distributed uniformly about the joint. Either fit-up bolts or high strength bolts may be used for this purpose.

Ungalvanized ASTM A325 bolts that have been tightened no more than one-third turn beyond "snug-tight" may be loosened and retightened. Ungalvanized ASTM A325 bolts tightened more than one-third turn beyond "snug-tight" shall not be reused without inspection by the Engineer. ASTM A490 bolts and galvanized ASTM A325 bolts which have been tightened beyond "snug-tight" shall not be reused. Retightening previously tightened bolts that may have been loosened by the tightening of adjacent bolts is not considered a reuse.

Smooth beveled washers shall be used when the bearing faces of the bolted parts have a slope of 1 to 20 or greater with respect to a plane normal to the bolt axis.

All bolts and nuts shall be lubricated prior to installation to assure that proper tension can be obtained.

05500.3.2.1.1 Bolting pre-installation verification. Fastener assemblies of each combination of diameter, length, grade and lot to be used in pretensioned connections shall be tested with a tension calibrator at the jobsite prior to commencing bolt installation on the work. Pre-installation verification shall be in accordance with the Research Council's Specification for Structural Joints.

05500.3.2.1.2 Direct tension indicators (DTIs). When using DTIs, tightening shall be done in accordance with the manufacturer's written instructions, the Research Council's Specification for Structural Joints, and the following.

Special care shall be taken to ensure that each DTI is of the correct capacity and grade for its intended use.

Any ASTM A325 or A490 bolt that has been tightened sufficiently to deform the DTI shall not be loosened and retightened.

Inspection of the installed DTI shall be in accordance with the manufacturer's written instructions.

Bolts found to be undertensioned shall be tightened to the correct tension by the Contractor. DTIs shall be inspected after the connection is snug-tight, but before pretensioning, and inspected again after pretensioning. Inspections shall use the appropriate feeler gauge recommended by the manufacturer.

05500.3.2.1.3 Twist-off bolts. When using twist-off bolts, tightening shall be done in accordance with the manufacturer's written instructions, the Research Council's Specification for Structural Joints, and the following.

Special care shall be taken to store the bolting components properly. Twist-off bolts shall not be relubricated, except by the bolt manufacturer.

Joints assembled with twist-off bolts shall first be snug-tightened. Compacting the joint to the snug-tight condition shall progress systematically from the most rigid part of the joint. If the splined end of a bolt is severed during snug-tightening of the connection, then the bolt shall be replaced. Once the connection has been compacted to a snug-tight condition, the bolts shall be pretensioned using tools and methods recommended by the manufacturer and progressing systematically from the most rigid part of the joint in a manner that will minimize relaxation of previously pretensioned bolts.

05500.3.2.1.4 Tightening – turn-of-nut. The turn-of-nut method for tightening bolts shall be performed in accordance with the Research Council's Specification for Structural Joints and the following.

Bolts installed in the work shall be in the same condition as the bolts used in the pre-installation verification procedure. Should the bolt conditions change due to additional corrosion or lubrication, then they shall be retested using the verification procedure.

Matchmarks shall be applied to both the nut and the bolt end after the "snug-tight" condition has been attained in each connection.

05500.3.3 Welding

Welding of structural steel shall be in accordance with Technical Supplementals Q100 and Q121 included in Section 01400, and the following.

All field welds shall receive 100 percent visual inspection. Butt joint splices, complete penetration T-joints, plate girder welds, and built-up column welds shall be tested as described in Technical Supplemental Q121.

All welding of stair stringer miters, closure plates, extension pieces, and similar welding applications shall be continuous welds and shall be ground smooth.

05500.3.4 Bar Grating Installation

Each section of rectangular bar grating shall be securely fastened in place with not less than two fasteners at each support.

Rectangular grating shall be installed so that spacer bars and load carrying bars in adjacent panels are in alignment.

Grating fasteners shall be in accordance with Article 05500.1.4 and shall be installed in accordance with the manufacturer's requirements. The fastener system shall be acceptable to the Engineer.

When saddle-clips are supplied, welded stud type bolts including nuts and washers shall be included. Saddle-clips shall be galvanized and as specified in the NAAMM manual. Studs shall be Nelson Stud Welding, Erico Products Blue Arc, KSM Welding Systems, or acceptable equal. Welded stud type bolts shall be size 1/4-20 with pitch diameter base. Stud length after welding shall be approximately 1/8 inch (3 mm) less than the grating depth. Nuts shall conform to ANSI B18.2.2. Studs, washers, and nuts shall be zinc plated in accordance with ASTM B633, service condition SC4.

When the Hilti Grating Disk System is used, disks shall be either electro-galvanized Type X-FCM or hot-dip galvanized Type X-FCM-F and carbon steel threaded studs shall be electro-galvanized Type EM8-15-14FP10. Grating disks shall be sized according to height of grating.

05500.3.5 Touchup Painting

The Contractor shall inspect fabricator applied paint films and inform the Owner of inadequate coatings prior to the erection of the materials. Damaged or inadequate paint films of shop primed structural steel materials, all accessible surfaces of field welds, unpainted surfaces at slip-critical connections, ungalvanized field connection bolts, and damaged galvanized surfaces shall be cleaned and touchup painted. .

Touchup paint for shop primed materials, all accessible surfaces of field welds, ungalvanized bolts, and damaged galvanized surfaces shall be as specified herein. ZRC Brush Applied Cold Galvanizing Compound shall be used for touchup of galvanized surfaces in lieu of Cold Galvanizing Spray.

05520 - Railings

05520.1 General Information

05520.1.1 Scope of Work

In this specification, the word railings is used to define guardrails and handrails. Guardrails are defined as a vertical protective barrier not less than 42 inches (1,067 mm) high erected along exposed edges of elevated walking surfaces for the purpose of minimizing the possibility of an accidental fall. The opening between rails shall be in accordance with the building code currently in effect at the project location. Railings at stairs can either be guardrails with handrails or handrails. A stair guardrail is a sloping guardrail system with the top rail not less than 42 inches (1,067 mm) vertical from the stair tread nose. A stair handrail is a sloping single rail with its top surface 30 inches (762 mm) to 34 inches (864 mm) vertical from stair tread nose, supported on brackets from a wall on a stairway or from the posts for the guardrail, and used for guidance or support. The railing system to be used at any location shall be as indicated on the drawings.

Work under these specifications shall include furnishing railings or erecting railings and providing miscellaneous materials and services complete as specified herein:

Scope of Supply:
Detailing and production of railing fabrication and erection.
Material procurement, fabrication, surface preparation, coating application and shipping in accordance with these specifications and the drawings.
Scope of Erection:
Receipt, inspection, unloading, storage and erection of materials furnished under these specifications, in accordance with the specifications and the drawings.
Supply and install touchup coatings.

05520.1.1.1 Miscellaneous Materials and Services. Miscellaneous materials and services not otherwise specifically called for shall be furnished by the Contractor in accordance with the following:

All bolts, nuts, and washers required for the materials furnished under these specifications.

All other component parts and connection materials required for a complete railing system, but not listed as being furnished by others.

Tests and inspections required by the specifications.

Document submittals as specified in Technical Supplemental Q500.

05520.1.1.2 Miscellaneous Materials and Services for Erection. Miscellaneous materials and services not otherwise specifically called for shall be furnished by the Contractor in accordance with the following:

Supply and install safety cables in all areas left unprotected by permanent railings. Safety cables shall be removed after the permanent railing systems are in place.

Supply all fit-up bolts, welding electrodes, welding, and other fasteners not supplied by the Owner that are necessary for the completion of the work.

Supply and install all expansion type concrete anchors necessary for the completion of the work. The manufacturer's installation instructions shall be strictly followed.

Supply, install and remove all temporary bracing, rigging, attachments, and supports.

Grout and grouting (refer to Section 03611).

Rail setting cement

Set, shim, level and grout all railing posts attached to concrete.

Tests and inspections required by the specifications.

Document submittals as specified in Technical Supplemental Q500.

05520.1.2 Not Used

05520.1.3 Performance and Design Requirements

Material and coating requirements for the railings and appurtenances shall be as indicated in Article 05520.1.5.

05520.1.4 Codes and Standards

Work performed under these specifications shall be done in accordance with the following codes and standards. Unless otherwise specified, the applicable governing edition and addenda to be used for all references to codes or standards specified herein shall be interpreted to be the jurisdictionally approved edition and addenda. If a code or standard is not jurisdictionally mandated, then the current edition and addenda in effect at the date of this document shall apply. These references shall govern the work except where they conflict with the Owner's specifications. In case of conflict, the latter shall govern to the extent of such difference:

Work	In Accordance With
Railings, including kickplates and angles and safety gates	AISC Steel Construction Manual, Fourteenth Edition
Railings, including kickplates and angles and safety gates	AISC Specification for Structural Steel Buildings, AISC 360-10.
Coatings	SSPC Paint Application Specification No. 1, "Shop, Field and Maintenance Painting"
Welding	ANSI/AWS D1.1

05520.1.5 Materials

All materials shall be new and undamaged and shall conform to pertinent AISC and ASTM standard specifications and the following requirements:

Component	Material
Railing Materials	

Component	Material
Steel pipe - carbon steel	
Type	ASTM A53 Type E or S, Grade B
Nominal diameter	1-1/2 inches (38 mm) standard
Posts	Schedule 80
Rails	Schedule 40
Round steel tube - carbon steel	
Type	ASTM A500, Grade B
Posts	HSS 1.900 X 0.188
Rails	HSS 1.900 X 0.145
Steel angles - carbon steel	
Type	ASTM A36/A36M carbon steel
Size – Posts and Rails (except handrail)	L 2-1/2 X 2-1/2 X ¼
Handrail	
Type	ASTM A53 Type E or S, Grade B
Size	1-1/2 inches, Schedule
Changes in Stair Rail Alignment and P-Loop Ends	
Angle railings	Accurately mitered joints
Round railings	Accurately mitered joints
Miscellaneous Materials	
Slip joints	Refer to Article 05520.1.6, Approved Manufacturers of Components
Kickplates and angles	ASTM A36/A36M carbon steel
Gates	Refer to Article 05520.1.6, Approved Manufacturers of Components
Bolts	ASTM A307, Grade A hexagon with lock washers and nuts
Welding electrodes	Low hydrogen types, with a minimum tensile strength = 70,000 psi (
Coating Requirements	
Carbon steel railings, including kickplates, angles, and safety gates - interior location	
Hot-dip galvanized	ASTM A123, ASTM A153, and ASTM A385

Component	Material
Carbon steel railings, including kickplates, angles, and safety gates - exterior location	
Hot-dip galvanized	ASTM A123, ASTM A153, and ASTM A385
Bolts, nuts, washers, and lock washers	
Plain	
Mechanically galvanized	ASTM B695 Class 50
Additional Coating Requirements	
Field touchup	ZRC Brush Applied Cold Galvanizing Compound

05520.1.6 Approved Manufacturers of Components

For the following components, the manufacturers listed below provide examples of the quality of workmanship required by these specifications. If the Contractor wants to propose a nonlisted manufacturer that is considered to provide an equivalent level of quality, this manufacturer must be identified and supporting testimony provided. Acceptance of the manufacturer as a substitute is at the discretion of the Engineer:

Component	Manufacturer
Safety gates	Fabenco self-closing, Benko Products Protect-O-Gates swing gate, PS Doors self-closing or acceptable equal
Slip joints	R & B Wagner single-lock splice locks or acceptable equal
Rail setting cement	ChemRex MBT "Set 45," or acceptable equal
Welded rail fittings	R & B Wagner or acceptable equal

05520.1.7 Test Requirements

The following testing shall be conducted in accordance with the specified source. This testing is to be considered part of the defined Scope of Work, and all associated costs are the responsibility of the Contractor:

Tests	In Accordance With	Conducted By
Nondestructive Testing of Welds	Technical Supplemental Specifications Q100 and Q121 included in Section 01400	Contractor

05520.1.8 Technical Attachments

Technical attachments relevant to the work under this section are listed in Section 01100.

05520.1.9 Supplemental Specifications

Technical supplemental specifications that are applicable to the work covered under this technical specification section are identified and included in Section 01400.

05520.2 Products

05520.2.1 General

Railings shall include kickplates and kick angles attached by shop fabrication where required, access opening gates where required, and bolting materials required for erection.

Coatings shall be applied after fabrication.

05520.2.2 Drawing Requirements

When the Contractor produces drawings, they shall be in accordance with Technical Supplemental Q500 and the following requirements:

Each drawing submitted shall indicate the name of the project, the unit designation, the contract title, the contract number, the name of the building structure, and the Contractor's name. In addition, the Owner's identification number will be affixed by the Engineer to each Contractor's initially submitted shop drawing. This number shall be maintained on all subsequent submittals of the drawings in the identical format and location as originally indicated by the Engineer.

Erection drawings shall be submitted with, or prior to, the submittal of the corresponding detail drawings.

A field bolt list indicating the number and length of each bolt shall be submitted.

Details of the proposed safety gates, slip joints, and rail connections or fittings shall be submitted with the first package of drawings.

Each detail drawing shall include a Bill of Material. The total weight, area, or length of material on each sheet in every represented unit price category listed in the Proposal section shall be listed on every detail drawing.

Each detail drawing shall indicate the mark number of each fabricated piece as assigned by the Contractor and list any material identification numbers assigned by the Engineer.

05520.2.3 Materials

Materials shall be new and unused; shall be smooth and free of mill scale, roll marks, and pitting; and shall be in accordance with these specifications.

05520.2.4 Fabrication

All projecting joints and sharp corners shall be ground smooth. Welded joints shall be of the flush type. Members shall be neatly coped and continuously welded at all junctions of posts and rails. Flattening of the rail or post ends at junctions of posts and rails will not be permitted. Fittings or other connectors shall not be used at junctions of posts and rails. For galvanized pipe or tube railings, joints shall have internal openings so there are no closed or blind sections of pipe or tubing. When the bottom of the railing post for pipe or tube railings is closed, a drain hole shall be provided on the vertical side of the post near the bottom. All welding shall be done neatly and substantially, with all fillets dressed to uniform radius, all excess metal removed, and all welds ground smooth and flush.

When assembled, all posts shall be vertical. Longitudinal members shall be parallel with each other and with the platform, walkway surface, slope of stairs, or other supporting members. In any section or run of railing, the center lines of all members shall be in true alignment, lying in the same vertical plane. Except as otherwise indicated on the drawings, the top rails shall run continuously over the posts, and the posts shall be continuous through the lower rail or rails.

Slip joints for expansion and contraction shall be provided in all straight runs exceeding 50 feet. Details of slip joints may be the manufacturer's standard, but shall be submitted to the Engineer for approval. Slip joints shall be shipped loose for field installation.

To facilitate alignment for welding in the field, an internal sleeve shall be tack welded to one side of the splice and shall project 2 inches beyond the splice.

Maximum spacing of posts shall be 7 feet.

Railings shall be fabricated in maximum lengths allowed for shipping.

05520.2.5 Welding

Welding of railings shall be in accordance with the requirements specified in Technical Supplementals Q100 and Q121 included in Section 01400. All welds shall receive 100 percent visual inspection.

05520.2.6 Coatings

Coatings shall be in accordance with the requirements specified in the Coating System Data sheets included as Technical Attachments.

Shop paint shall not be applied within 3 inches (75 mm) of any field welded connection. When galvanizing is specified for railings, all connection materials shall be galvanized.

05520.3 Execution

05520.3.1 Erection

Railings shall be rigidly attached to the supporting structure as indicated on the drawings. Railings that intersect structural bracing shall be field cut and welded to the bracing.

All welding shall be done neatly and substantially. After welding railing posts and rails to bracing or other supports, all fillets shall be dressed to a uniform radius and all slag and spatter shall be removed. Rail splices shall be welded and ground smooth except where slip joints are required. Handrail splices at stair landings shall be adjusted for fit-up prior to welding where necessary as part of normal installation. Slip joints shall be installed so that the joint may open and close with temperature changes.

Railings set in concrete shall be set in sockets formed by means of accurately aligned sleeves cast in the concrete. The positions of all sleeves shall be carefully checked with the spacing of the posts. Posts for removable railings shall be secured to the sleeve as indicated on the drawings. Posts for fixed railings shall be wedged in accurate alignment, and the space between the posts and sleeves shall be filled with rail setting cement.

After installation, railings shall have the longitudinal rails parallel and horizontal, except for railings attached to sloping surfaces, such as stair stringers, which shall parallel the sloping surface. Posts shall be vertical.

After completion of all other work under these specifications, railings shall be checked for final alignment. Rails shall not be out of plane more than 3/8 inch in 12 feet from the center line in any direction for each run of railing. Railing runs shall be defined as uninterrupted distances such as from column to column,

vertical wind bracing, stairs, etc. Vertical posts shall not be out of plane in either direction more than 1/8 inch. Railings that do not meet these requirements shall be straightened or replaced at no additional cost to the Owner.

05520.3.2 Touchup Painting

Damaged primer paint and all accessible surfaces of field welds on carbon steel railings shall be cleaned and prime painted as specified in these technical specifications.

05520.3.3 Touchup Galvanizing

Galvanized surfaces that are scratched or otherwise damaged during delivery, unloading, or erection, and surfaces of field welds shall be thoroughly cleaned by wire brushing the damaged area to remove all loose, cracked, or bruised galvanizing. Cleaned areas shall then be painted with ZRC Brush Applied Cold Galvanizing Compound. Spray products shall not be utilized.

05531 - Grating

05531.1 General Information

05531.1.1 Scope of Supply

Work under these specifications shall include furnishing grating or erecting grating and providing miscellaneous materials and services complete as specified herein:

Scope of Supply:
Detailing and production of grating fabrication and erection drawings.
Material procurement, fabrication, surface preparation, coating application and shipping in accordance with these specifications and the drawings.
Scope of Erection:
Receipt, inspection, unloading, storage and erection of materials furnished under these specifications, in accordance with the specifications and the drawings.
Furnish all grating fasteners
Supply and install touchup coatings.

05531.1.1.1 Miscellaneous Materials and Services. Miscellaneous materials and services not otherwise specifically called for shall be furnished by the Contractor in accordance with the following:

Stair tread fasteners.

Checkered plate fasteners to grating for composite systems.

Tests and inspections required by the specifications.

Document submittals as specified in Technical Supplemental Q500.

05531.1.1.2 Miscellaneous Materials and Services for Erection. Miscellaneous materials and services not otherwise specifically called for shall be furnished by the Contractor in accordance with the following:

Supply all welding electrodes, welding, and grating fasteners that are necessary for the completion of the work.

Supply, install and remove all temporary bracing, rigging, attachments, and supports.

Shims where required to level adjacent grating panels

Tests and inspections required by the specifications.

Document submittals as specified in Technical Supplemental Q500.

05531.1.2 Not Used

05531.1.3 Performance and Design Requirements

Material and coating requirements for the grating and appurtenances shall be as indicated in Article 05531.1.5.

05531.1.4 Codes and Standards

Work performed under these specifications shall be done in accordance with the following codes and standards. Unless otherwise specified, the applicable governing edition and addenda to be used for all references to codes or standards specified herein shall be interpreted to be the jurisdictionally approved edition and addenda. If a code or standard is not jurisdictionally mandated, then the current edition and addenda in effect at the date of this document shall apply. These references shall govern the work except where they conflict with the Owner's specifications. In case of conflict, the latter shall govern to the extent of such difference:

Work	In Accordance With
Bar grating	ANSI/NAAMM MBG 531
Heavy-duty bar grating	ANSI/NAAMM MBG 532
Checkered steel floor plate	ASTM A786/A786M
Steel for banding of panel ends and kickplates	ASTM A36/A36M, ASTM A1011/A1011M, or acceptable equal
Pipe sleeves	ASTM A36/A36M, ASTM A1011/A1011M, ASTM A53, or acceptable equal
Reticulated grating	Manufacturer's standard

05531.1.5 Materials

All materials shall be new and undamaged and shall conform to pertinent AISC and ASTM standard specifications and the following:

Component	Material
Grating Materials	
Rectangular bar grating	
Mark	W-19-4 (1.25 by 0.1875 inch) serrated steel
Banding of panel ends	Required, size 1 by 0.125 inch
Kickplate	4 inches above top of grating by 0.25 inch thick
Stair treads (rectangular bar grating)	
Stair tread size	30 inches long by 1 inch deep by 12 inches wide serrated steel
Nosings	Checkered plate nosings or Wooster Type 120 Alumogrit

Component	Material
Fasteners	
Grating	Saddle-clips with Nelson, Erico, KSM studs or Hilti grating disk system
Stair treads	ASTM A307, Grade A 0.375 inch diameter bolts with nuts and lock washers
Stair tread nosings	Shop welded or Flathead bolts, nuts, and lock washers
Heavy-duty rectangular bar grating	
Mark	W-22-4 (3 by 0.25 inch) steel
Banding of panel ends	Required, size 2.5 by 0.125
Kickplate	4 inches above top of grating by 0.25 inch thick
Fasteners	Saddle-clips with Nelson, Erico, KSM studs or Hilti grating disk system
Floor plate and grating composite	
Rectangular bar grating	W-19-4 (1.0 by 0.1875 inch)
Banding of panel ends	Required, size 1 by 0.125 inch
Kickplate	4 by 0.25 inch
Checkered steel floor plate	ASTM A786/A786M (0.25 inch thick)
Fasteners	Composite grating floor plate connection to support steel; #12 self-tapping flathead screws
Reticulated metal floor grating	
Type	Serrated steel, 14 gauge, 1.5 inch channel depth, 7 inch minimum width
Banding of panel ends	Required, same depth as panel ends by 0.1875 inch
Checkered steel floor plates	ASTM A786/A786M, 0.25 thick
Coating Requirements	
Rectangular bar grating	
Rectangular bar grating, including shop attached kickplates and stair treads	Hot-dip galvanized
Nosings	Hot-dip galvanized
Fasteners	
Bolts for stair treads	Galvanized
Bolts for nosings	Galvanized

Component	Material
Heavy-duty rectangular bar grating	Hot-dip galvanized
Reticulated floor grating	Hot-dip galvanized
Checkered steel floor plates	Hot-dip galvanized

05531.1.6 Approved Manufacturers of Components

For the following components, the manufacturers listed below provide examples of the quality of workmanship required by these specifications. If the Contractor wants to propose a nonlisted manufacturer that is considered to provide an equivalent level of quality, this manufacturer must be identified and supporting testimony provided. Acceptance of the manufacturer as a substitute is at the discretion of the Engineer:

Component	Manufacturer
Rectangular metal bar grating and stair treads and heavy-duty bar grating	AMICO Klemp or IKG Industries
Stair tread nosings - rectangular bar grating	
Checkered plate nosings	AMICO Klemp or IKG Industries
Alumogrit safety nosings	Wooster Products, Inc.
Checkered steel floor plate	AMICO Klemp or IKG Industries
Reticulated metal floor grating and stair treads	GS Metals "Grip Strut Safety Grating" or Morton "Grip-Trac"

05531.1.7 Test Requirements

The following testing shall be conducted in accordance with the specified source. This testing is to be considered part of the defined Scope of Work, and all associated costs are the responsibility of the Contractor:

Tests	In Accordance With	Conducted By
Nondestructive Testing of Welds	Technical Supplemental Specifications Q100 and Q121 included in Section 01400	Contractor

05531.1.8 Technical Attachments

Technical attachments relevant to the work under this section are listed in Section 01100.

05531.1.9 Supplemental Specifications

Technical supplemental specifications that are applicable to the work covered under this technical specification section are identified and included in Section 01400.

05531.2 Products

05531.2.1 General

The floor grating types described in this section are as follows. The grating types may not all be included in this Contract:

Rectangular bar grating.

Heavy-duty rectangular bar grating.

Grating floor plate composite.

Reticulated floor grating.

05531.2.2 Drawing Requirements

When the Contractor produces drawings, they shall be in accordance with Technical Supplemental Q500 and the following requirements:

Each drawing submitted shall indicate the name of the project, the unit designation, the contract title, the contract number, the name of the building structure, and the Contractor's name. In addition, the Owner's identification number will be affixed by the Engineer to each Contractor's initially submitted shop drawing. This number shall be maintained on all subsequent submittals of the drawings in the identical format and location as originally indicated by the Engineer.

Erection drawings shall be submitted with, or prior to, the submittal of the corresponding detail drawings.

The detail drawings shall clearly show all edge conditions including banding and kickplates.

Weld sizes and locations shall be clearly shown.

Each detail drawing shall include a Bill of Material. The total weight, area, or length of material on each sheet in every represented unit price category listed in the Proposal section shall be listed on every detail drawing.

Each detail drawing shall indicate the mark number of each fabricated piece as assigned by the Contractor and list any material identification numbers assigned by the Engineer.

05531.2.3 Rectangular Bar Grating (including Heavy-Duty)

Grinding of crossbar ends is not required if the spacer bars project no more than 1/8 inch (3 mm) beyond the outside bearing bars and the overall panel width used in laying out the work is adjusted to allow for extensions.

Kickplates shall be provided where indicated on the drawings.

Where openings are indicated in gratings, such as for the passage of pipes, grating sections shall be laid out so that each opening will be centered on a joint between sections. All openings shall be provided with a kickplate of formed steel plate or standard weight steel pipe welded to the bearing bars.

All kickplates attached to grating shall extend 1 inch below the top of grating.

Grating fasteners shall be supplied in accordance with Article 05531.1.5. The quantity of fasteners to be supplied shall allow each section of rectangular bar grating to be fastened in place with not less than two fasteners at each support plus a 2 percent overage.

When saddle-clips are supplied, welded stud type bolts including nuts and washers shall be included. Saddle-clips shall be galvanized and as specified in the NAAMM manual. Studs shall be Nelson Stud Welding, Erico Products Blue Arc, KSM Welding Systems, or acceptable equal. Welded stud type bolts shall be size 1/4-20 with pitch diameter base. Stud length after welding shall be approximately 1/8 inch less than the grating depth. Nuts shall conform to ANSI B18.2.2. Studs, washers, and nuts shall be zinc plated in accordance with ASTM B633, service condition SC4.

When the Hilti Grating Disk System is used, disks shall be either electro-galvanized Type X-FCM or hot-dip galvanized Type X-FCM-F and carbon steel threaded studs shall be electro-galvanized Type EM8-15-14FP10. Grating disks shall be sized according to height of grating.

05531.2.4 Stair Treads (Bar Grating Type)

Stair treads shall be as specified. Spacing for bearing bars shall not exceed 1-3/16 inches center-to-center.

Tread width shall be greater than tread run by 1/2 inch minimum.

End carrier plates shall be provided and shall be welded to both ends of the bearing bars as detailed in the NAAMM manual. Punching of carrier ends shall be as detailed in the NAAMM manual.

Each tread shall be provided with a continuous one-piece nosing attached to the tread.

A sufficient number of fasteners shall be provided to bolt the treads to the stair stringers, plus an overage of fasteners of 2 percent.

05531.2.5 Floor Plate and Grating Composite

Grating fabrication requirements shall be as specified under Article 05531.2.3, Bar Grating.

Checkered floor plate and grating composite, when erected in place, shall lie flat and have no burrs or projecting edges or corners above the floor line. Dished or depressed areas shall be corrected so that water and debris will not collect therein.

Checkered floor plate and grating assemblies to consist of checkered floor plate of the thickness specified shop welded to the grating panel. Connect checkered floor plate to grating panels with 3/16 inch fillet welds, 1-1/2 inch long, spaced at 1'-0" centers along all panel edges and at 1'-6" centers interior to the panel edges at every 5th bearing bar. Checkered floor plate shall be welded to the grating panels prior to galvanizing.

The checkered floor plate and grating composite shall be connected to the structural steel members with flat head self-drilling screws. Minimum screw diameter shall be #12 with a maximum spacing of 3'-0" and a minimum of two (2) screws per panel edge. Screws shall be coated for outdoor service. Prior to galvanizing, Contractor shall drill the required countersunk hole in the checkered floor plate for a flush screw installation. Screw shall be installed in accordance with the manufacturer's recommendations.

Contractor shall provide a sufficient number of fasteners, plus an overage of fasteners of 2 percent.

Detailing and fabrication requirements for floor plate and floor grating shall be as indicated in the individual sections specified herein.

Poorly fitting checkered floor plate and grating composite will be rejected and shall be replaced at the Contractor's expense.

Floor plates shall be fabricated to provide the edge clearances indicated on the drawings and a clearance of not more than 1/8 inch between adjacent plates. All cuts shall be made with mechanical cutting tools or plasma arc. Burning will not be accepted.

Floor plates shall be attached to the grating as specified herein or as indicated on the drawings.

05531.2.6 Reticulated Floor Grating

Fabrication shall not begin until the Engineer has reviewed and accepted the Contractor's fabrication drawings.

Each unit of reticulated floor grating shall consist of a horizontal reticulated area of short span, not to exceed 11-3/4 inches (300 mm) wide, supported between formed side channels. Units shall be of sizes and shapes that will fit snugly together to conform to the arrangement indicated on the Owner's drawings. Arrangements of the individual pieces shall be such that all longitudinal and transverse joints shall be continuous from adjacent sections. The arrangement shall be subject to the review of the Engineer.

Kickplates shall be provided where indicated on the drawings. Kickplates shall extend the full depth of the grating. Kickplates shall be welded to the side channels and to each diamond of the reticulated area.

All reticulated grating shall lie flat with no tendency to rock when installed. Grating shall be galvanized after fabrication and straightened after galvanizing.

The reticulated grating section at the head of each stair shall be provided with an abrasive nosing.

05531.3 Execution

05531.3.1 Rectangular Bar Grating

Each section of rectangular bar grating shall be securely fastened in place with not less than two fasteners at each support.

Rectangular grating shall be installed so that spacer bars and load carrying bars in adjacent panels are in alignment.

Stair treads shall be bolted to the stair stringers with galvanized unfinished bolts, nuts, and lock washers furnished with the treads.

Grating fasteners shall be in accordance with Article 05531.1.5 and shall be installed in accordance with the manufacturer's requirements. The fastener system shall be acceptable to the Engineer.

When saddle-clips are supplied, welded stud type bolts including nuts and washers shall be included. Saddle-clips shall be galvanized and as specified in the NAAMM manual. Studs shall be Nelson Stud Welding, Erico Products Blue Arc, KSM Welding Systems, or acceptable equal. Welded stud type bolts shall be size 1/4-20 with pitch diameter base. Stud length after welding shall be approximately 1/8 inch (3 mm) less than the grating depth. Nuts shall conform to ANSI B18.2.2. Studs, washers, and nuts shall be zinc plated in accordance with ASTM B633, service condition SC4.

When the Hilti Grating Disk System is used, disks shall be either electro-galvanized Type X-FCM or hot-dip galvanized Type X-FCM-F and carbon steel threaded studs shall be electro-galvanized Type EM8-15-14FP10. Grating disks shall be sized according to height of grating.

05531.3.2 Floor Plate and Grating Composite

Floor plate and grating composite, when erected in place, shall lie flat and have no burrs or projecting edges or corners above the floor line. Dished or depressed areas shall be corrected so that water and debris will not collect therein.

The checkered floor plate and grating composite shall be connected to the structural steel members with flat head self-drilling screws. Minimum screw diameter shall be #12 with a maximum spacing of 3'-0" and a minimum of two (2) screws per panel edge. Screws shall be coated for outdoor service. Screw shall be installed flush in accordance with the manufacturer's recommendations.

05531.3.3 Not Used.

05531.3.4 Not Used.

05531.3.5 Reticulated Grating

Each section of reticulated grating shall be securely fastened in place with not less than two fasteners at each support. Fasteners shall be as recommended by the grating supplier and supplied with the grating except where welding is indicated on the drawings. Anchoring devices shall be fastened to the supporting steel with stud type bolts furnished and installed under these specifications.

Studs shall be Nelson Stud Welding, Erico Products Blue Arc, KSM Welding Systems, or acceptable equal welded stud type bolts.

Stud type bolts shall be size 1/4-20 with pitch diameter base and shall be attached to the supporting steel by the arc-stud welding process. The finished length after welding shall be approximately 1/8 inch (3 mm) less than the grating depth. Nuts shall conform to ANSI B18.2.2. Studs, washers, and nuts shall be zinc plated in accordance with ASTM B633.

The direction of grating span shall be the same at all stair landings.

Reticulated stair treads shall be bolted to the stair stringers with galvanized unfinished bolts, nuts, and lock washers furnished with the treads.

05531.3.6 Additional Supporting Steel

Where necessary to produce a stable platform, additional supporting steel shall be provided for grating support around openings as directed by the Engineer. This supporting steel shall be rolled shapes furnished and installed in accordance with the American Institute of Steel Construction or as specified by the Engineer.

05531.3.7 Protection from Damage

After grating has been installed, it shall be protected from damage. Grating which is damaged before Acceptance of the work under these specifications shall be replaced by the Contractor without cost to the Owner.

05531.3.8 Touchup Painting

Damaged galvanized surfaces shall be prepared and touched up with ZRC Brush Applied Cold Galvanizing Compound shall be used for touchup in lieu of Cold Galvanizing Spray.

09900 - Field Applied Protective Coatings

09900.1 General

Cleaning, surface preparation, and coating application shall be as specified herein and shall meet or exceed the coating manufacturer's recommendations. When the manufacturer's minimum recommendations exceed the specified requirements, the Contractor shall comply with the manufacturer's minimum recommendations.

This section covers the requirements for shop and field application of protective coatings and painting for components that are not galvanized. The painting systems specified are expected to provide an optimum life expectancy of 10 years from the time of original painting. The environment shall be considered a Severe Environment – Heavy Industrial and Chemical Plant area with high levels of fumes and fallout as defined by the Steel Structures Painting Council (SSPC). Coatings shall be suitable for an industrial environment. The optimum life of a coating system will be considered the time until first maintenance painting/touchup should occur, when 3 to 5 percent breakdown of the topcoats occurs, before active rusting begins. Surfaces which will be inaccessible after assembly shall be protected for the life of the equipment.

Painting work shall include the protection of surfaces not to be painted and surface preparation, furnishing and applying paint materials, and other work incidental to painting which is required to properly execute the painting work.

All external metallic surfaces of equipment provided under these specifications which are subject to corrosion shall be cleaned and prepared in accordance with the Coating System Data Sheets listed under Technical Attachments in the Technical Specification, and shall be protected by the specified coatings. Surfaces which will be inaccessible after assembly shall be protected for the life of the equipment.

Painting shall be in accordance with Owner's color scheme.

09900.1.1 Scope

This section covers field applied protective coatings, including surface preparation, protection of surfaces, inspection, and other appurtenant work for equipment and surfaces designated to be coated with heavy-duty industrial coatings. Touch-up painting, where required, shall restore or complete any damaged, inadequate, or masked surfaces to the full coating specified on the applicable Coating System Data Sheet.

Except for those surfaces excluded hereinafter, all exposed surfaces of facilities constructed or otherwise incorporated into the scope of work shall be painted. All exposed surfaces of equipment components and structures that are not finish painted shall be field painted by Contractor.

Exposed surfaces shall mean all interior and exterior surfaces which are not encased or covered by the equipment and which are visible and accessible for painting.

Areas which would be difficult or impossible to paint after all construction is complete shall be painted at a stage during construction when painting is possible.

Abraded or damaged areas of shop primed surfaces shall be cleaned and touchup painted before applying finish paint system. Abraded or damaged areas of shop finish painted surfaces shall be repaired by spot priming and repainting.

Accessories for equipment shall be painted with the same paint system specified for the equipment.

Exposed surfaces of electrical conduit, conduit boxes, and fittings shall be painted only where they are adjacent to painted parts of the equipment. These surfaces shall be painted the same color as the adjacent surfaces.

09900.1.1.1 Surfaces to be Painted. Exposed surfaces of all equipment, piping, valves, and hangers, unless excluded hereinafter, shall be finish painted.

09900.1.1.2 Surfaces Not to be Painted. Except as otherwise specified or directed by Owner, the surfaces of the following shall not be painted:

- Aluminum surfaces
- Brass
- Bronze
- Bus duct enclosures
- Cable trays and supports
- Chromium plated metals
- Concrete floors, sidewalks, curbs, and paving
- Electrical conductors, insulated, or uninsulated
- Electrical conduits, wire ways, and junction boxes (except as otherwise specified)
- Embedments (galvanized)
- Floor plates
- Gauges
- Galvanized grating and hand railing
- Galvanized structural steel
- Glazing
- Hardware
- Light fixtures, except supports
- Polished or machined surfaces
- Porcelain enameled surfaces
- Porcelain bushings
- Rotating shafts and couplings
- Rubber belts, skirting, gaskets, and idler disks
- Stainless steel surfaces

Bearing surfaces and nameplates shall not be painted, but shall be coated with an easily removable rust preventative. Sliding surfaces and threads shall not be painted, but shall be properly lubricated. Surfaces to be field welded shall be left unpainted for a distance of 3 inches from the weld and painted after the welding is complete.

09900.1.1.3 Surfaces to be Touchup Painted. After erection, touchup coatings shall be furnished and applied to abraded or damaged areas on shop-coated equipment surfaces. Surfaces shall be properly prepared before application of coatings. The touchup coatings shall be of the same manufacturer or Owner approved equivalent, type and color as the shop coatings, with surface preparation, undercoating, and paint application procedures in accordance with the original paint manufacturer's recommendations. Repair painting shall be applied as required to produce a finish equal to the shop paint finish.

Where touchup coatings are provided by the equipment supplier, those coatings shall be used for touchup and surface preparation, undercoating and coating application procedures furnished by the supplier shall be followed.

Use of aerosol spray paint is not acceptable. Refer to JEA Contractor Safe Work Practices Manual for acceptable practices.

09900.1.2 Not Used

09900.1.3 Coating Applications and Material Requirements

Paint systems shall be in accordance with the following listing. Paint system designations refer to the Coating System Data Sheets listed under Technical Attachments in the Technical Specification:

Application	Coating System Number
Outdoor exposed steel (not galvanized), shop and field erected uninsulated carbon steel tanks and vessels, piping supports, Contractor furnished equipment	1712
Valves and fittings, electric motors, electrical equipment, instruments and control panels	Manufacturer's standard coatings (if standard finish is primer, Contractor shall finish coat equipment)

09900.1.4 Codes and Standards

Work performed under these specifications shall be done in accordance with the following codes and standards. Unless otherwise specified, the applicable governing edition and addenda to be used for all references to codes or standards specified herein shall be interpreted to be the jurisdictionally approved edition and addenda. If a code or standard is not jurisdictionally mandated, then the current edition and addenda in effect at the date of this document shall apply. These references shall govern the work except where they conflict with the Engineer's specifications. In case of conflict, the latter shall govern to the extent of such difference:

Work	In Accordance With
Fabrication details, surface finish requirements, and proper design considerations for tanks and vessels to be lined for immersion service	NACE RP0178
Mineral and Slag Abrasives	SSPC-AB 1
Newly Manufactured or Remanufactured Steel Abrasives	SSPC-AB 3
Solvent cleaning	SSPC-SP 1
Hand tool cleaning	SSPC-SP 2
Power tool cleaning	SSPC-SP 3
White metal blast cleaning	SSPC-SP 5 / NACE No. 1
Near white blast cleaning	SSPC-SP 10 / NACE No. 2
Commercial blast cleaning	SSPC-SP 6 / NACE No. 3
Brush-off blast cleaning	SSPC-SP 7 / NACE No. 4
Power tool cleaning to bare metal	SSPC-SP 11

Work	In Accordance With
Surface Preparation and Cleaning of Steel and Other Hard Materials by High- and Ultra-High Pressure Water Jetting Prior to Recoating	SSPC-SP 12
Surface Preparation of Concrete	SSPC-SP 13
Shop, field, and maintenance painting of steel	SSPC-PA 1
A guide to safety in paint application	SSPC-PA Guide 3
Standard procedure for evaluating painting contractors	SSPC-QP 1
Visual standard for abrasive blast cleaned steel	SSPC-VIS 1
Visual standard for power and hand tool cleaned surfaces	SSPC-VIS 3

09900.1.5 Not Used

09900.1.6 Not Used

09900.1.7 Test Requirements

The following testing shall be conducted in accordance with the specified source. This testing is to be considered part of the defined Scope of Work, and all associated costs are the responsibility of the Contractor:

Tests	In Accordance With	Conducted By
Indicating moisture in concrete by the plastic sheet method	ASTM D4263	Contractor
Indicating oil or water in compressed air	ASTM D4285	Contractor
Measurement of wet film thickness by notch gauges	ASTM D4414	Contractor
Field measurement of surface profile of blast cleaned steel	ASTM D4417	Contractor
Pull-off strength of coatings using portable adhesion testers	ASTM D4541	Contractor
Discontinuity (Holiday) testing of nonconductive protective coatings on metallic substrates	ASTM D5162	Contractor

Tests	In Accordance With	Conducted By
Measurement of dry paint thickness with magnetic gauges	SSPC-PA 2	Contractor

09900.1.8 Technical Attachments

Technical attachments relevant to the work under this section are listed in Section 01100.

09900.1.9 Supplemental Specifications

Technical supplemental specifications that are applicable to the work covered under this technical specification section are identified and included in Section 01400.

09900.1.10 Submittals

A coating system submittal shall be provided in accordance with Supplemental Specification Q500 in Section 01400 and shall include:

Product data sheets.

Material safety data sheets (MSDS).

Surface preparation requirements and application instructions for each coating system furnished under this section.

Ventilation, dehumidification or heating requirements.

Repair procedures for damaged areas and detected holidays.

Quality assurance / quality control plan.

Name of coating inspector and level of certification held.

A separate coating system submittal shall be developed and submitted for each variation or change in a coating system or surface to be coated.

Protective coating and lining work shall be undertaken by applicators, including supervisors and workers, qualified by commercial experience installing the types of materials specified. To satisfy this experience requirement, the applicator shall be certified to SSPC-QP 1 or equivalent and shall submit to the Owner a work history demonstrating a record of performance of such applications.

When the proposed products will be in contact with potable water, the Contractor shall submit certifications that the proposed systems are in compliance with ANSI/NSF 61.

Contractor shall submit color cards for all coatings proposed for use, together with specifications to the Owner for review and color selection.

Approval of the Contractor submittals must be provided by the Owner prior to the commencement of work.

09900.1.11 Quality Assurance

09900.1.11.1 Certification. The Contractor shall review and approve in writing the coating manufacturer's recommendations for the intended service. Any variations from these specifications or the

coating manufacturers published recommendations shall be submitted in writing and approved by the Owner.

09900.1.11.2 Manufacturer's Services. The services provided by the coating manufacturer shall include review of the project before surface preparation; certification, in writing, of the applicator and the coating materials to be used.

09900.2 Products

09900.2.1 Materials

Paint materials shall be as indicated on the Coating System Data Sheets listed under Technical Attachments in the Technical Specification.

All coating products shall be received and stored in accordance with the coating manufacturer's recommendations. Paint materials shall be stored in sealed, original labeled containers bearing manufacturer's name, type of paint, brand name, color designation, and instructions for mixing and/or reducing. The manufacturers' recommended application instructions for each type of paint shall be included with each shipment of paint.

Except for catalyzed coatings, all paint shall be factory mixed in correct proportions and consistency suitable for direct application in warm weather without addition of thinners. Pigments shall be fully ground, maintaining a soft paste consistency, capable of being readily and uniformly dispersed to a complete homogeneous mixture.

Materials from the same manufacturer shall be applied for all coats in each coating system.

Except as otherwise acceptable to Owner, coatings shall be formulated and compounded by manufacturers named in the Coating System Data Sheets listed under Technical Attachments in the Technical Specification.

All coatings shall conform to the air quality regulations applicable at the location of use. Coating materials that cannot be guaranteed by the manufacturer to conform, whether or not specified by product designation, shall not be used.

09900.2.2 Approved Manufacturers

Except as otherwise acceptable to the Owner, coatings shall be manufactured, formulated, and compounded by coating manufacturers named in the Coating System Data Sheets. Abrasive blast media shall be supplied by abrasive blast materials manufacturers named in the Blast Media Data Sheets.

09900.2.3 Finish Paint Colors

Finish paint colors will be generally selected from the manufacturer's standard line of colors to match Owner's standard specification for paint colors as listed below. Sample boards showing the proposed color scheme for each area shall be prepared and submitted to Owner for color selection. The sample boards shall include samples of each finish material labeled with the manufacturer and color name of each sample. A minimum of three final sample boards shall be submitted after final Owner selection.

All color references shall be made to the Federal Standard Colors as specified in Federal Standard 595a, as published by the U.S. Government Printing Office. Where a particular gloss is not shown in Federal Standard 595a the color shall be so selected to represent that gloss of the specified color as if it were shown in the Federal Standard.

Federal Standard Color Number	Basic Color	Normal Use or Application
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11105	Red	Fire Protection Equipment
14491	Green	Piping Valves
24491	Green	Panelboards
26081	Gray	Console and Panel Board Bases/Trim Metal Doors and Frames Louver Frames Floor Plates Kick Plates Wire Partitions All Exterior Structural Steel Stairs, Platforms and Railings Pipe Hangars
27038	Black	Valve Operator Handles

09900.3 Execution

09900.3.1 Surface Preparation

Coating work shall include the protection of surfaces not to be coated and surface preparation, furnishing and applying materials, and other work incidental to coating that is required to properly execute the work. All exposed surfaces of the equipment shall be coated as directed on the Coating System Data Sheets. The remainder of the plant equipment will be coated under separate specifications.

All surfaces to be coated shall be clean and dry and shall meet the recommendations of the coating manufacturer for surface preparation. Oil and grease shall be completely removed by using techniques described in SSPC-SP 1 before mechanical cleaning is started.

Surfaces shall be free of cracks, pits, projections, or other imperfections that would interfere with the formation of a smooth, unbroken coating film.

Freshly coated surfaces shall be protected from dust and other contaminants. The gloss on previously coated surfaces shall be dulled if necessary for proper adhesion of topcoats.

When applying touchup coating or repairing previously coated surfaces, the surfaces to be coated shall be cleaned as recommended by the coating manufacturer and the edges of the repaired area shall be feathered by sanding or wire brushing to produce a smooth transition that will not be noticeable after the coating is applied. All coatings made brittle or otherwise damaged by heat of welding shall be completely removed.

The quality of compressed air shall be verified in accordance with ASTM D4285 prior to performing abrasive blasting. The test will be carried out at the beginning of each shift and witnessed by the coating inspector.

09900.3.1.1 Not Used.

09900.3.1.2 Ferrous Metal Surfaces. Ferrous metal surfaces shall be prepared for coating by using one or more of the following cleaning procedures as specified: solvents (SSPC-SP1); hand tools (SSPC-SP2); power tools (SSPC-SP3 or -SP11); abrasive blasting (SSPC-SP5, -SP6, -SP7, or -SP10);

or water jetting (-SP12). Oil and grease shall be completely removed in accordance with SSPC-SP1 before beginning any other cleaning method. Surfaces of welds shall be scraped and ground as necessary to remove all slag and weld spatter.

All cut or sheared edges shall be ground smooth to a 1/8 inch minimum radius for all material 1/4 inch thickness and larger. For material thickness less than 1/4 inch all cut or sheared edges shall be ground smooth to a radius equal to 1/2 the material thickness. Grinding of rolled edges on standard shapes with a minimum radius of the 1/16 inch will not be required.

Unless specified in the Coating System Data Sheets, all ferrous metal surfaces shall have all welds ground smooth and free of all defects in accordance with NACE Standard RP0178, Appendix C, Designation D.

All blasting residue, waste, and accumulation shall be removed before coating application.

Cleaned surfaces shall be coated or lined with the specified coating, primer, or touchup coat within 6 hours of cleaning, or before rust bloom occurs. No blast cleaned surfaces shall stand overnight before coating.

The surface preparation specified herein are minimums, and if the requirements printed in the coating manufacturer's data sheets exceed the limits specified, the value printed on the data sheets shall become the minimum requirement

09900.3.1.3 Not Used.

09900.3.2 Mixing and Thinning

Coating shall be thoroughly mixed each time any is withdrawn from the container. Coating containers shall be kept tightly closed except while coating is being withdrawn.

Coating shall be factory mixed to proper consistency and viscosity for hot weather application without thinning. Thinning will be permitted only as necessary to obtain recommended coverage at lower application temperatures. In no case shall the wet film thickness of applied coating be reduced, by addition of coating thinner or otherwise, below the thickness recommended by the coating manufacturer. Thinning shall be done in compliance with all applicable air quality regulations.

Uniform suspension of coating pigments shall be maintained during application.

Jobsite tinting will not be permitted.

09900.3.3 Application

Coating shall be applied in a neat manner that will produce an even film of uniform and proper thickness, with finished surfaces free of runs, sags, ridges, laps, and brush marks. In no case shall coating be applied at a rate of coverage greater than the maximum rate recommended by the coating manufacturer.

A skid resistant additive shall be incorporated into the top layer of coating systems which are applied to permanent walking surfaces.

Each layer of the coating system shall be of a visibly different color or shade from the preceding coat. Coatings shall be factory tinted.

A minimum of 20 foot-candles (215 lux) of illumination shall be provided for surfaces to be coated.

Ventilation in the work area shall be adequate to remove all particulates and solvent vapors. Where natural ventilation is inadequate, a mechanical ventilation system shall be employed. The ventilation system shall provide a clean air supply during all phases of coating operations.

Coating failures will not be accepted and shall be entirely removed down to the substrate and the surface recoated. Failures include but are not limited to checking, cracking, teardrops, fat edges, fisheyes, or delamination.

Coating materials shall be applied in accordance with the manufacturer's recommendations by competent and experienced applicators.

09900.3.4 Protection of Surfaces

Throughout the work, proper dropcloths, masking tapes, and other protective measures shall be provided to protect surfaces from accidental spraying, splattering, or spilling of coatings. Damage resulting from coating operations shall be corrected and repaired. Coatings deposited on surfaces not being coated shall immediately be removed.

The Contractor shall remove and reinstall, or provide adequate in-place protection for, valve and equipment identification tags, gauges, installed hardware, accessories, lighting and electrical components, factory finished materials, plumbing fixtures and fittings, and other materials that may become splattered or damaged by coating materials.

09900.3.5 Environmental Conditions

Coatings shall not be applied, except under environmentally controlled conditions, during wet, damp, or foggy weather, or when windblown dust, dirt, debris, or insects will collect on freshly applied coating.

Do not install coating or lining material if substrate temperature is within 5° F of the dewpoint temperature or if the relative humidity is greater than 95%.

Coatings shall not be applied at temperatures lower than the minimum temperature recommended by the coating manufacturer, or to metal surfaces where conditions are likely to cause condensation, regardless of the air temperature. When necessary for proper application, a temporary enclosure shall be erected and the environment properly conditioned until the coating has fully cured.

Coatings shall not be applied at temperatures higher than the maximum temperature recommended by the coating manufacturer. Where coatings are applied during periods of elevated ambient temperatures, the Contractor shall ensure that proper application is performed including adherence to all re-coat window requirements. Precautions shall be taken to reduce the temperature of the surface application, especially for metal, at elevated temperatures above 100°F including shading the application area from direct sunlight, applying coating in the evening or at night, and ventilating the area to reduce the humidity and temperature.

Concrete that is expelling air, or increasing in temperature, shall not be coated.

09900.3.6 Field Quality Control

The following inspection and testing shall be performed: visual inspection, surface profile, wet and dry film thickness, spark testing, and adhesion testing. The Owner shall be responsible for review of all Contractor testing documentation and shall also establish hold points indicating periodic on-site review of the Contractor's test procedures.

The Contractor shall provide daily documented atmospheric condition reports to the Owner including temperature and humidity every four hours during application and temperature monitoring during cure of the coating system.

Personnel performing or supervising the inspection of surface preparation, coating application and quality control testing shall be qualified as a Certified Coating Inspector in accordance with the requirements of NACE International or previously approved equivalent program.

09900.3.6.1 Surface Profile Testing. The surface profile for ferrous metal surfaces shall be measured for compliance with the specified minimum profile in accordance with ASTM D4417. The surface profile for concrete shall comply with SSPC-SP 13, Table 1, for severe service.

09900.3.6.2 Visual Inspection. The surface of the protective coatings shall be visually inspected.

09900.3.6.3 Film Thickness. Coating film thickness shall be verified by measuring the film thickness of each coat as it is applied and the dry film thickness of the entire system. Dry film thickness shall be measured in accordance with SSPC-PA 2. Wet film thickness shall be measured with a gauge that will measure the wet film thickness within an accuracy of ± 0.5 mil in accordance with ASTM D4414.

09900.3.6.4 Spark Testing. Coatings shall be spark tested using an acceptable electrical spark tester set at the recommended voltage. The Owner shall observe the spark testing and shall verify the testing equipment is working properly before the spark testing of the coating is started. The electrode movement shall be continuous and shall proceed in a systematic manner that will cover 110 percent of the coated surface.

Spark testing for coatings on metal shall be done in accordance with ASTM D5162.

All detected holidays and pinholes shall be marked and repaired as recommended by the coating manufacturer.

09900.3.6.5 Adhesion Testing. An adhesion test shall be conducted on a properly prepared and coated steel or concrete surface that is acceptable to the Contractor and the Owner. The test area shall be at least 2 square feet or larger to allow a minimum of three tests to be conducted. The test area shall be coated with the specified system and cured as recommended by the coating manufacturer. Pull-off strength adhesion tests of the coating shall be conducted in accordance with ASTM D4541 using an Elcometer tensile adhesion tester. At least three adhesion tests shall be conducted and the results averaged. Adhesion strength shall equal or exceed the minimum adhesion strength recommended by the coating manufacturer and shall exceed the tensile strength of the substrate.

If the coating fails the adhesion test, the cause of the failure shall be determined and corrected before reconducting the test.

13902 - Fire Protection and Detection Systems

13902.1 General

This section covers the design, shop fabrication, and installation requirements for the fixed suppression systems, early warning detection systems, alarm systems, and portable fire protection equipment. Fire protection equipment shall be arranged to appropriately protect the plant and equipment in the event of fire.

It is not the intention to specify herein all details of design and construction. The Contractor shall ensure that the equipment has been designed, fabricated, and erected in accordance with all engineering codes, standards, and governmental regulations applicable to the specified service.

The Contractor shall have full responsibility for compliance with the requirements of these specifications. Review and/or approval of drawings, data, or specifications by the Owner or Engineer with regard to general design and controlling dimensions does not constitute acceptance of any designs, materials, or equipment that will not fulfill the functional or performance requirements established herein.

In case of a conflict within the technical requirements, the following hierarchy shall apply:

- (1) Mandatory governmental regulations and codes.
- (2) Engineer-specified requirements provided on the data sheets.
- (3) Requirements provided in the technical attachments.
- (4) Requirements provided in the technical specifications.
- (5) Requirements provided in Section 01400.
- (6) Referenced industry codes and standards and material specifications.

13902.1.1 Scope of Work

The Contractor shall furnish a complete foam fire protection system as defined herein.

13902.1.2 Not Used

13902.1.3 Performance and Design Requirements

Performance and design requirements for the fire protection and detection systems are indicated herein and in Section 13902.4 included at the end of this section.

All conductors shall be in dedicated fire protection conduit. Conductors shall not be permitted in trays. Contractor drawings shall clearly indicate all wiring or equipment that is supplied or installed by others and call out design and material requirements (manufacture and code/standard). The Contractor is responsible for reviewing materials and designs specified to be supplied by others, as part of the overall fire protection system, to ensure compliance with codes, standards and manufacturers' requirements. A few examples are: power limited or non-power limited circuits, manufacturer approved wire list, gauge limitations, distance limitations, and insulation requirements.

13902.1.4 Codes and Standards

Work performed under these specifications shall be done in accordance with the following codes and standards. Unless otherwise specified, the applicable governing edition and addenda to be used for all references to codes or standards specified herein shall be interpreted to be the jurisdictionally approved

edition and addenda. If a code or standard is not jurisdictionally mandated, then the current edition and addenda in effect at the date of this document shall apply:

Work	In Accordance With
Overall design	NFPA, AHJ, and applicable codes
Fire detection system equipment components	NFPA, FM*, UL*, ANSI, ASME, ASTM, NEMA, IEEE, AWS, AWWA, and DOT
Heat detection	NFPA 70, 72, and 850
Indicating devices	NFPA 70, 72, and 850
Control panel initiating and indicating devices	NFPA 70, 72, and 850
Pipe thread tolerances	NFPA 13 and ANSI B1.20 Pipe Threads
Foam system	NFPA 11, 11A, 11C or 16
Foam pressure proportioner tank	ASME Section VIII
Hose systems	NFPA 14
Rotating lights and site fire alarm warning horns	UL, NFPA 70 and 72
Fire alarm system wiring (initiating devices, notification appliances, solenoids, signaling line circuits)	NFPA, AHJ, and applicable codes
Wiring and installation work	National Electrical Code
*Equipment supplied shall be listed by Underwriters Laboratories Inc. (UL) or shall be included in the Approval Guide as published by Factory Mutual (FM) Engineering. Equipment shall be considered as FM-approved only if it conforms to the characteristics and limitations of the individual component approvals and if those components are used in the service intended by the Approval Guide.	

Any conflict between referenced codes or standards, or between the standards and these specifications, shall be referred immediately to the Engineer who shall determine which standard or specification requirements shall govern.

13902.1.5 Materials

The following materials shall be used:

Component	Material
Piping	
Wet-pipe systems	Galvanized piping not required. Minimum Schedule 40
Foam piping	ASTM A53, Grade B, black steel, Schedule 40
Flanges	

Component	Material
Flanges	Hot-dip galvanized following welding when connected to galvanized pipe (see Section 13902.2.1.7.2)
Foam flanges	Class 150 RF flanged ends
Foam fittings	Standard weight, Class 150 RF flanged ends
Piping 2 inches and smaller	Screwed or shop welded. (UL or FM Listed grooved style fittings are acceptable)
Piping larger than 2 inches	Welded flanges or shop welded connections. (UL or FM Listed grooved style fittings are acceptable)
Pipe accessories	
Foam pressure proportioner tank	Carbon steel
Gaskets	Red rubber sheets, 1/16 inch (1.6 mm) thick, full face, ASTM D2000, No. 2AA705A13L14
Thread sealant	Teflon ribbon, Optional for gas suppression piping: Locktite 592 sealant and primer NF-73656
Thread tolerances	NFPA 13 and ANSI B1.20.1 pipe threads
Bolts and nuts	Steel machine bolts
Plugs	Square heads and of a metal dissimilar to fitting to which they are attached
Piping supports	Per NFPA 13 and 15
Supplementary support beams (pipe support)	ASTM A36, fireproof construction
Riser lugs	ASME B31.1
Valves	
Gate valves	OS&Y type, flanged ends
Control panels (local)	NEMA 4

13902.1.6 Approved Manufacturers of Components

For the following components (if any), the manufacturers listed below provide examples of the quality of workmanship required by these specifications. If the contractor wants to propose a non-listed manufacturer that is considered to provide an equivalent level of quality, the manufacturer must be identified and supporting testimony provided. Acceptance of the manufacturer as a substitute is at the discretion of the Engineer:

Component	Manufacturer

13902.1.7 Test Requirements

The following testing shall be conducted in accordance with the specified source. This testing is to be considered part of the defined Scope of Work, and all associated costs are the responsibility of the Contractor. At Owners discretion, Owners Insurance Representative may witness all demonstrations of the fire protection system performance:

Tests	In Accordance With	Conducted By
Entire System	Applicable NFPA and building codes	Contractor

13902.1.8 Technical Attachments

Technical attachments relevant to the work under this section are listed in Section 01100.

13902.1.9 Supplemental Specifications

Technical supplemental specifications that are applicable to the work covered under this technical specification section are identified and included in Section 01400.

13902.2 Products

13902.2.1 Not Used

13902.2.2 Foam Fire Protection System

13902.2.2.1 General. The following articles cover design, performance, and construction requirements for the foam fire protection system.

The Contractor shall furnish and install a complete foam fire protection system including automatic water inlet valve; proportioner; foam concentrate tank; foam chamber assemblies; foam hose stations with hose nozzles and cabinets; all necessary piping, valves, and piping accessories between the existing fire water supply valve CSTG-BV-123 and the fuel oil storage tank foam chamber assemblies; and rate compensated heat detectors, alarms, controls, wiring, conduit, and instrumentation as required for complete systems. The system shall be manufactured by National Foam System, Inc., or acceptable equal.

13902.2.2.2 Code Requirements. The design and construction of the foam fire protection system and component parts shall comply with all local regulations and codes as well as that specified in Article 13902.1.4.

13902.2.2.3 Foam Fire Protection System Requirements. The fixed foam fire protection system shall be designed, furnished, and erected to protect the indicated hazard. Locations and design requirements are described on the arrangement drawings and design data sheets.

Locations of, and mounting instructions for, all electrically powered detection and alarm devices shall be provided with the Contractor's design drawings.

Minimum foam solution delivery rate is specified in the Section 13902.4. The amount of concentrate shall be at least sufficient for the largest single hazard protected or group of hazards that are to be protected simultaneously.

The discharge time shall be specified at the rate described in the Section 13902.4. The Contractor shall provide initial concentrate fill of bladder tank with a 3 percent foam concentration.

Upon detection of water inlet valve opening, a fire alarm bell shall be activated.

Equipment location and other pertinent information are specified on design data sheets and indicated on the drawings included as part of these specifications.

13902.2.2.4 Foam Fire Protection System Component. The components of the foam fire protection system shall be provided in accordance with the following requirements.

13902.2.2.4.1 Bladder tank. The bladder proportioner tank shall be complete with integral support legs. The tank shall be sized for the system plus additional hose streams as required by NFPA 11.

Tank working pressure shall be at least 175 psi. The tank shall be complete with plugged inspection openings, fill connection with fill funnel, drain with valve, and connection for pressure proportioner operating head.

13902.2.2.4.2 Water inlet valve. Water inlet valve will be either manual or automatic solenoid. Section 13902.4 specifies the type of activation.

The manual water inlet valve shall be quarter turn ball valves. The valves shall be opened manually by personnel. Two separate manually operated valves shall be provided for the foam system and the hose station. The valves shall come complete with tamper switches and water flow pressure switches downstream of the water inlet valves to alarm as indicated herein.

13902.2.2.4.3 Ratio controller. The ratio controller shall, when the water inlet valve is open, pressurize the bladder tank and, by use of an orifice, draw foam liquid into the water stream in a quantity proportional to water flow.

13902.2.2.4.4 Foam chamber assembly. Foam chambers shall be furnished and installed on the hazard. The foam chambers shall be Type MCS foam chambers as manufactured by National Foam System, Inc. or acceptable equal. When used with tanks, the chambers shall be designed for bolting to the tank shell above the high oil level. The chambers shall be provided with glass diaphragm vapor leakage seal to prevent vapor leakage through the chamber and piping. An integral foam maker with selective orifice plate and an inside deflector plate shall be furnished for the chamber.

13902.2.2.4.5 Hose station. Foam hose stations shall be provided for spill fires as required by NFPA 11. The hose stations shall be complete with hose angle valve, cap, and chain.

A foam hydrant equipment house shall contain the following: 200 feet of 1-1/2 inch hose suitable for outdoor installation, aluminum variable foam spray/stream ball shutoff type hand held nozzle, and universal spanner wrench.

Foam hydrant equipment house shall be Potter-Roemer, Inc. Model 6035, or acceptable equal. Lettering 4 inches high shall clearly indicate "Foam House."

13902.2.2.4.6 Piping, valves, and accessory equipment. Piping, fittings, valves, and accessory equipment design and construction shall conform to the latest issue of NFPA 11.

Piping shall be galvanized as specified in the Supplemental Specifications in Section 01400.

When multiple systems are required, each system, the tank, and the foam hose shall have system isolation gate valves to isolate each system independently. The gate valve shall be FM-approved OS&Y gate valves. Each shall be complete with a tamper switch as indicated in the following article.

13902.2.2.4.7 Local Control panel. A local control panel shall be furnished for the foam fire protection system. This panel shall be tagged and located as indicated on coverage drawings. The panel shall be of the same manufacturer and incorporate the same design features specified in Articles 13902.2.1.11 and 13902.2.4. The enclosure shall meet the requirements of NEMA 4. The system shall be UL-listed and/or FM-approved in the supplied configuration.

The following distinctive alarms shall be provided at the local panel for the foam system:

Alarm Condition	Source	Type of Alarm
Fire (water flow-tank system)	Pressure switch (Style B)	Fire
Fire (water flow-foam hose)	Pressure switch (Style B)	Fire
System isolation valve not fully open (tank)	Tamper switch (Style B)	Supervisory
System isolation valve not fully open (foam hose)	Tamper switch (Style B)	Supervisory
System main isolation gate valve not fully open	Tamper switch (Style B)	Supervisory
Fire alarm bell circuit trouble*	Open or ground in wiring to bell (Style Y)	Trouble
Fire detected	Heat detector (Style D)	Fire
Detector circuit trouble	Open or ground in detecting wiring (Style D)	Trouble
Water pressure switch circuit trouble (tank)	Open or ground in wiring to switch (Style B)	Trouble
Water pressure switch circuit trouble (foam hose)	Open or ground in wiring to switch (Style B)	Trouble
System isolation valve tamper switch circuit trouble (tank)	Open or ground in wiring to switch (Style B)	Trouble
System isolation valve tamper switch circuit trouble (foam hose)	Open or ground in wiring to switch (Style B)	Trouble
System main isolation valve tamper switch circuit trouble	Open or ground in wiring to switch (Style B)	Trouble
Loss of primary power at panel/battery in use*	Local panel	Trouble
Battery voltage low	Low voltage in battery	Trouble
Battery short, charger, or wiring trouble	Open or ground in circuits	Trouble
System normal	Local panel	N/A
Lamp test	N/A	Switch
Acknowledge	N/A	Switch

Alarm Condition	Source	Type of Alarm
System reset	N/A	Switch
*These alarms need not be duplicated when two or more suppression systems are controlled by one panel.		

Any fire detector in alarm shall initiate a fire alarm condition at the local control panel and at the existing main Fire Alarm Panel located in the Plant Control Room via the existing Fire alarm interface panel IP-4 in the fire water pump building. The Contractor shall incorporate the new fire alarm signals into the existing Fire Alarm/Protection System. This will require modifications to the existing Fire Alarm System/Panels.

13902.2.2.4.8 Heat detectors. Heat detectors shall be Fenwal Detect-A-Fire Model 27121-0 fire detection systems or acceptable equal. Detectors shall be mounted in Crouse-Hinds Model EAHC 2701 (NEMA 9) fixtures, or acceptable equal. Spacing of detectors shall be in accordance with manufacturer's guidelines; however, not less than three heat detectors shall be located above the high liquid level around the perimeter of the tank, with one additional detector located at the top of the cone. Contractor shall furnish and install all conduit, wiring, fittings, and supports necessary for class A wiring from the hazard to the local control panel.

13902.2.2.4.9 Foam house. An enclosure shall be provided to enclose the pressure bladder tank, water inlet valve, pressure proportioner operating head, 120/208V distribution power panel, and local control panel(s). The enclosure shall be provided with lights, duplex receptacle(s) and 120 volt or 208V single phase space heater(s) to prevent freezing. A dedicated 60 Amp, 208V single phase with neutral feeder circuit from the fire water pump building lighting panel (638-PN-0005) shall be routed to the foam house distribution panel. Electrical devices associated with the foam house enclosure requiring power shall be pre-wired to the distribution panel. The enclosure shall have the same manufacturer and incorporate the same features as specified in Article 13902.2.1.12.

13902.3 Execution

Erection and installation of fire protection system equipment and piping shall be in accordance with the requirements of the environmental criteria in the front end sections of this document.

Fire Protection and Detection Systems Specification Sheets

General Data						
Contractor's scope						
Engineer	Yes					
Furnish	Yes					
Construct	Yes					
Type of system(s) required						
Foam	Yes					
Suppression/Detection Systems						
Low Expansion Foam System						
System designation	Fuel Oil					
Area or equipment protected	Two (2) Fuel Oil Storage Tanks (No. 2 fuel oil)					
Detection or actuation device	Spot type heat detector (rated at ___ ° F)					
Coverage density	0.1 gpm/ft ²					
Fire Protection System Control Panels						
Panel Designation	System Designation	Panel Location and Mounting Criteria			Auxiliary Functions (note: all relays for shutdown functions shall be located within 3 feet of the controlling panel or in a relay panel designated below (if applicable)).	
CFOA-CPL-1	Fuel Oil	Fire Pump Building				
Foam Criteria						
System Designation	Flammable/ Combustible Liquid Classification	Number of Hose Stations	Number of Discharge Outlets	Minimum Discharge Time	House Location and Size	Tank Roof Type
500,000 gal No. 2 Fuel Oil Tank 1, 2, & Unloading Area	Class II	2	1			Center Column Supported Coned Roof or Self-Supporting Conical
Fire Alarm Annunciation Requirements of Main FAP (Existing)						
Item	Alarm Description		Type of Signal		Source of Signal	
1	Fire (water flow-tank system)		Fire		Pressure switch	
2	Fire (water flow-foam hose)		Fire		Pressure switch	

3	Fire detected	Fire	Heat detector
4	Trouble	Trouble	
General information			
Electrical power supplied			
Voltage, volts		120	
Frequency, hertz		60	
Communication between FAAP and local panels		Network signaling line communication (Style 6 or 7) or Conventional relay contact or Contractor's option	
Communication between local panels and field devices		Addressable signaling line (Style 6 or 7) or Conventional devices or Contractor's option	
Additional equipment required			

15225 - General Service Pipe

15225.1 General

15225.1.1 Scope of Supply

Scope of supply shall include furnishing materials for fuel oil and demineralized water piping systems as indicated herein and in the attachments listed in Article 15225.1.8. Materials shall include straight lengths of pipe, fittings, flanges, and unions. Gaskets and flange bolting materials shall be furnished if indicated in the attachments. Special welding adapters shall be furnished if indicated in the attachments.

15225.1.1.1 Pipeline List. The Pipeline List specifies the operating and design conditions and types of pipe to be used with each piping system. The Pipeline List designates the pipeline identification code; line description; operating, design, and test pressures and temperatures; pipe material, nominal sizes, and corresponding schedule or wall thickness; valve class rating, end preparation requirements, and material; insulation class; remarks; and special features.

PIPELINE LIST						
PIPELINE CODE	PIPELINE DESCRIPTION	OPERATING PRESSURE/ DESIGN PRESSURE/ TEST PRESSURE	OPERATING TEMPERATURE /DESIGN TEMPERATURE	PIPE MATERIAL/ PIPE SIZE	ANSI CLASS/ INSULATION THICKNESS	REMARKS
CFOA-L-CSA	Fuel Oil Unloading	30 psi 60 psi 90 psi	70 F 105 F	ASTM A106 Gr B 8" SCH 40 10" SCH 40	STD	
CFOA-L-CSB	Fuel Oil Forwarding	120 psi 150 psi 225 psi	70 F 105 F	ASTM A106 Gr B 8" SCH 40	STD	
CFOA-L-CSBS	Fuel Oil Forwarding	120 psi 150 psi 225 psi	70 F 105 F	ASTM A106 Gr B 1" SCH 80	STD	
CFOA-L-CSC	Fuel Oil Recirculation	120 psi 150 psi 225 psi	70 F 105 F	ASTM A106 Gr B 6" SCH 40	STD	
CFOA-L-CSD	Fuel Oil Unloading Thru Berm	30 psi 60 psi 90 psi	70 F 105 F	ASTM A106 Gr B 8" SCH 40	STD	Contain with FRP through berm
CFOA-L-CSE	Fuel Oil Forwarding Thru Berm	120 psi 150 psi 225 psi	70 F 105 F	ASTM A106 Gr B 8" SCH 40	STD	Contain with FRP through berm
CFOA-L-CSF	Fuel Oil Recirculation Thru Berm	120 psi 150 psi 225 psi	70 F 105 F	ASTM A106 Gr B 6" SCH 40	STD	Contain with FRP through berm

CFPA-L-DIA	Foam Fire Water Supply	125 psi 150 psi 225 psi	80 F 110 F	C151 A21.51 CL50 6" CL350 12" CL350	STD	UL listed/FM approved.
CWSH-L-SSA	Demin Water Unloading	75 psi 100 psi 150 psi	70 F 105 F	A312 TP 304 6" 10S 8" 40S	STD	
CWSH-L-SSB	Demin Water Forwarding	70 psi 100 psi 150 psi	70 F 105 F	A312 TP 304 8" 10S	STD	
CWSH-L-SSC	Demin Water Recirculation	70 psi 100 psi 150 psi	70 F 105 F	A312 TP 304 4" 10S	STD	
CWSH-L-SSD	Demin Water Drain/Spare	70 psi 100 psi 150 psi	70 F 105 F	A312 TP 304 4" 10S	STD	
CWWC-L-PEA	Fuel Oil Containment Drain	15 psi 30 psi 45 psi	70 F 105 F	HDPE ASTM D3350 4" DR17 8" DR17	STD	

15225.1.1.2 Not Used.

15225.1.1.3 Not Used.

15225.1.1.4 Plan and Section Drawings. Plan and section drawings indicate the routing of piping for which materials are to be furnished under this Contract. The Contractor shall use the plan and section drawings to determine the quantities of straight lengths of piping, fittings, flanges, gaskets, bolting, etc., to be furnished for each section of pipeline.

15225.1.1.5 Piping and Instrument Diagrams/Flow Diagrams. Piping and instrument diagrams or flow diagrams indicate the materials and line sizes of piping systems for which materials are to be furnished under this Contract.

15225.1.1.6 Additional Scope.

Welding rod and other associated consumables for welded joint piping systems	Furnished by Contractor
Solvent cement and other associated consumables for solvent cement joint piping systems	Furnished by Contractor
Special tools required for erecting the furnished plastic piping materials	Furnished by Contractor

15225.1.2 Not Used

15225.1.3 Performance and Design Requirements

Performance and design requirements for the general service pipe to be furnished under this section of these specifications are as follows:

Acceptable Types of Pipe

Steel plate piping of the seam welded type	Not allowed
Fiberglass reinforced plastic (FRP) pipe shall be	Contractor's choice of filament wound type or centrifugally cast type

15225.1.4 Codes and Standards

Work performed under these specifications shall be done in accordance with the following codes and standards. Unless otherwise specified, the applicable governing edition and addenda to be used for all references to codes or standards specified herein shall be interpreted to be the jurisdictionally approved edition and addenda. If a code or standard is not jurisdictionally mandated, then the current edition and addenda in effect at the date of this document shall apply. These references shall govern the work except where they conflict with the Engineer's specifications. In case of conflict, the latter shall govern to the extent of such difference:

Work	In Accordance With
Materials for piping and application of piping materials	The most current edition of the ASME Code for Pressure Piping, B31.1, Power Piping, including all addenda thereto
Sizes, schedule numbers, and dimensions of carbon steel and alloy steel pipe, and stainless steel pipe schedules not covered by ANSI B36.19M	ANSI/ASME B36.10M
Sizes and dimensions of stainless steel pipe designated as Schedule 5S, 10S, 40S, or 80S	ANSI/ASME B36.19M
Wall thickness tolerances for carbon steel and alloy steel pipe	ASTM A530
High density polyethylene (HDPE) pipe	ASTM F714
Butt weld fitting manufacturing standard	ANSI/ASME B16.9 and ANSI/ASME B16.28
Socket-weld and threaded forged steel fittings manufacturing standard and minimum pressure class ratings	ANSI/ASME B16.11
Carbon steel flanged fittings	ANSI B16.5
Steel castings for pipe system components	In accordance with Technical Supplemental Specification Q400
Welding adapters	Paragraph 104.3 of ANSI/ASME B31.1
Manufacturing standards for mechanical joint and push-on joint ductile iron and cast iron fittings	ANSI/AWWA C153/A21.53 and ANSI/AWWA C111/A21.1
Steel flange construction requirements	ANSI/ASME B16.5

Work	In Accordance With
Compressed fiber gaskets and rubber gaskets	ANSI B16.21
Ring joint gaskets	ANSI B16.20
Flange bolting requirements - alloy steel bolting	ANSI/ASME B16.5
Flange bolting requirements - carbon steel bolting	ANSI B16.1
Carbon steel bolting dimensional standards	ANSI B18.2.1 and ANSI/ASME B18.2.2
Cleaning interior surface of carbon steel pipe	PFI Standard ES-5, Articles 4.2.1 and 4.2.2
Abrasive shot blast cleaning	PFI Standard ES-29 (sand or silica bearing blasting materials are not allowed)

15225.1.5 Materials

The following materials shall be used:

Component	Material
Steel pipe	
Carbon steel	ASTM A106 Grade B
Stainless steel	
304 stainless steel	ASTM A312, Type 304 or 304L, Schedule 40S minimum for 2 inch and smaller, or as specified on attachment(s)
HDPE pipe	ASTM D3350, with a cell classification of 345434C
Stainless steel tubing	ASTM A213, fully annealed Type 316 with carbon content greater than 0.04 percent
Carbon steel flange material standards, ANSI Pressure Classes 150 and 300	ASTM A181/A181M or ASTM A105/A105M
Carbon steel flange material standards, ANSI Pressure Class 600 and higher	ASTM A105/A105M
Carbon and alloy steel butt weld fitting material standards	ASTM A234/A234M

Component	Material
Stainless steel butt weld fitting material standards	ASTM A403/A403M
Alloy steel bolting materials for use with piping with design temperatures less than 750° F	
Studs	ASTM A193/A193M Grade B7
Nuts	ASTM A194/A194M Grade 2H
Carbon steel bolting materials	ASTM A307 Grade B, ASTM A563 Grade A heavy hex nuts
All bolting plating (applies to alloy and carbon steel bolting)	Cadmium plating in accordance with ASTM B766 or mechanically deposited zinc coating in accordance with ASTM A153

15225.1.6 Approved Manufacturers of Components

For the following components, only the listed manufacturers are recognized as maintaining the level of quality of workmanship required by these specifications. If the Contractor wants to propose a nonlisted manufacturer that is considered to provide an equivalent level of quality, this manufacturer must be identified and supporting testimony provided. Acceptance of the manufacturer as a substitute is at the discretion of the Owner:

Component	Manufacturer
FRP pipe and fittings	
Centrifugally cast	Fibercast Company - Fibercast
Filament wound	Ameron Corrosion Control Division - Bondstrand Reinforced Plastics Systems Inc. - ABCO Plastics Division Smith Fiberglass Products Inc. Fibercast Company - Fibercast
HDPE pipe and fittings	
Factory Mutual (FM) approved	Phillips Petroleum Company - Driscopipe 1000 FM Class 200 Amsted Industries - Plexco EHMW - Class 200 - FM Bluestripe - Class 200 - FM Redstripe - Class 200 - FM Poly Systems Incorporated, KWH Class 200

Component	Manufacturer
Non-FM applications	Phillips Petroleum Company - Driscopipe 1000 Amsted Industries - Plexco PE 3408 Poly Systems Incorporated, KWH - Sclairpipe
Tubing fittings	Crawford Swagelok Parker Hannifin
Integrally reinforced forged branch outlet fittings	Bonney Forge WFI
Compressed fiber gaskets	Richard Klinger, Inc. - Klingersil Garlock, Inc. - Blue-Gard
Spiral wound gaskets	Flexitallic Gasket Company Garlock
Spiral wound gasket filler	Flexitallic Gasket Company - Flexite Super Garlock
Cloth inserted rubber gaskets	Manville
Abrasive blast cleaning media	Ervin Industries, AMASTEEL Cast Steel Abrasives

15225.1.7 Test Requirements

The following testing shall be conducted in accordance with the specified source. This testing is to be considered part of the defined Scope of Work, and all associated costs are the responsibility of the Contractor:

Tests	In Accordance With	Conducted By
Hydrotests of piping components are not required as part of the piping material supply, but are required as part of piping erection Work if included in this Contract.	N/A	N/A

15225.1.8 Technical Attachments

Technical attachments relevant to the work under this section are listed in Section 01100.

15225.1.9 Supplemental Specifications

Technical supplemental specifications that are applicable to the work covered under this technical specification section are identified and included in Section 01400.

15225.2 Products

15225.2.1 Piping Material Requirements

All pipe shall be in accordance with the applicable codes and standards designated in Article 15225.1.4 and the attachments thereto. Except as otherwise specified, schedule numbers, sizes, and dimensions of piping shall conform to the applicable standards specified in Article 15225.1.4.

Material substitutions, except as specified on the attachments listed in Article 15225.1.8, shall not be made without written approval by the Engineer.

15225.2.1.1 Steel Pipe. Carbon steel and alloy steel pipe shall be ungalvanized seamless type unless otherwise specified.

15225.2.1.2 Not Used.

15225.2.1.3 Not Used.

15225.2.1.4 Fiberglass Reinforced Plastic Pipe. When Article 15225.1.3 indicates that it is the Contractor's choice whether to furnish filament wound type FRP pipe or centrifugally cast type FRP pipe, the following Bondstrand/Fibercast/Smith offerings are considered by the Engineer to be equally acceptable:

Bondstrand 2000 - Fibercast Centricast RB-1520 - Smith Green Thread.

Bondstrand 4000 - Fibercast Centricast Plus RB-2530 - Smith Green Thread.

Bondstrand 5000 - Fibercast Centricast Plus CL-2030 - Smith Chem Thread.

If the Contractor proposes to furnish FRP pipe products other than the ones listed above, the Contractor shall submit a list of proposed products for specific applications for the Owner acceptance.

FRP pipe which will be exposed to sunlight or so specified in the attachment(s) shall be ultraviolet ray resistant (pigments are acceptable).

15225.2.1.5 High Density Polyethylene Pipe. HDPE pipe shall be FM Approved Class 200 for fire protection service and shall be as specified in the attachment(s) by standard dimension ratio (SDR) for all other services or as required by the overall design.

15225.2.1.6 Not Used.

15225.2.1.7 Not Used.

15225.2.2 Tubing

Stainless steel tubing shall conform to the material specification indicated in Article 15225.1.5. Stainless steel tubing for use with tubing fittings shall not exceed Rockwell B80 hardness.

Wall thickness for tubing 3/4 inch and smaller shall not be less than the following. The thicknesses indicated are the minimum acceptable:

	Wall Thickness, in. (mm)
Outside Diameter of Tubing, in.	Stainless Steel
1/4 (6)	0.035 (0.889)
3/8 (10)	0.065 (1.651)
1/2 (12)	0.065 (1.651)
5/8 (16)	0.095 (2.413)
3/4 (20)	0.109 (2.769)

Wall thickness of Type K copper tubing shall be in accordance with ASTM B88.

15225.2.3 Fittings

If a quantity list is included as a part of this specification, fittings shall be constructed of materials indicated on the list. If the Contractor determines that the fittings are to be furnished based on pipe routing and piping system design conditions, the materials for pipe fittings shall be equivalent to the material of the pipe with which they are used, except that plastic or rubber lined cast iron or ductile iron fittings shall be used with plastic or rubber lined steel pipe, as indicated on the attachment(s).

15225.2.3.1 Steel Fittings. Unless otherwise indicated on the attachment(s), steel fittings 2-1/2 inches and larger shall be butt welding type and steel fittings 2 inches and smaller shall be socket welding type.

Butt Welding Fittings. Butt welding fitting wall thicknesses shall be equal to the pipe wall thickness with which they are used. Fittings shall be manufactured in accordance with the applicable standards listed in Article 15225.1.4.

Unless otherwise indicated on the drawings, elbows shall be of the long radius type and conform to the applicable standards listed in Article 15225.1.4.

Forged Steel Fittings - Socket-Welded and Threaded. Forged steel fittings shall be used for socket-welded and threaded connections. Socket-welded and threaded fittings shall conform to the applicable standards listed in Article 15225.1.4. Metal thicknesses of fittings shall be adequate to provide actual bursting strengths equal to or greater than those of the pipe with which they are to be used.

Minimum pressure class rating of socket-welded and threaded fittings shall be in accordance with the applicable standard listed in Article 15225.1.4.

Integrally Reinforced Forged Branch Outlet Fittings. Specially designed integrally reinforced forged branch outlet fittings shall be furnished if so indicated on the attachment(s).

For piping systems designed and routed by the Contractor, specially designed integrally reinforced forged branch outlet fittings (weldolets or sweepolets) may be furnished in lieu of reducing outlet tees when the main run pipe wall thickness does not exceed 3/4 inch. Unless otherwise specified, all branch connections 2 inches and smaller shall be made with specially reinforced welding adapters, sockolets (SOL), or threadolets (TOL). These adapters shall be integrally reinforced forged branch outlet fittings.

Integrally reinforced forged branch outlet fittings shall be manufactured by a manufacturer listed in Article 15225.1.6.

15225.2.3.2 Not Used.

15225.2.3.3 Not Used.

15225.2.3.4 Not Used.

15225.2.3.5 High Density Polyethylene Fittings. Fittings for HDPE piping systems shall have pressure ratings equivalent to the straight pipe sections with which they will be used. Fittings shall be of the molded or mitered type as indicated on the drawings. If not indicated on drawings, fittings shall be molded type unless otherwise accepted by the Engineer. Fittings shall be of the butt fusion weld, socket fusion weld, or saddle type as recommended by the pipe manufacturer for the point of application within the system.

15225.2.3.6 Not Used.

15225.2.3.7 Not Used.

15225.2.3.8 Ductile Iron Fittings. Fittings shall conform to the standards listed in Article 15225.1.4.

Except as otherwise specified, interior surfaces of ductile iron pipe fittings shall be cement lined.

Except as otherwise specified, the exterior surfaces of all ductile iron pipe fittings shall be coated with a bituminous material.

15225.2.3.9 Tubing Fittings. Stainless steel fittings shall be used with stainless steel tubing. Fittings for use with stainless steel tubing in sizes smaller than 3/4 inch shall be of the flareless grip type, and fittings for use with tubing in sizes 3/4 inch and larger shall be socket-weld type. Fitting material and bursting strength shall be equivalent to the tubing with which they are used.

15225.2.4 Flanges

Flanges shall conform to applicable standards indicated in Article 15225.1.4. Unless otherwise specified, flanges shall be as follows:

For the case where the Contractor determines flanges to be furnished based on attached drawings or based on the Contractor's overall design, flanges mating with flanges on piping, valves, and equipment shall be of sizes, drillings, and facings that match all connecting flanges.

Flange class ratings shall be adequate to meet the design pressure and temperature specified in the attachment(s) for the piping with which they are used.

Flange materials shall be equivalent to the pipe with which they are used.

15225.2.4.1 Steel Flanges. All steel flanges 2-1/2 inches and larger shall be of the weld neck type and all steel flanges 2 inches and smaller shall be of the socket type. Steel flanges shall have raised face flange preparation-except as specified otherwise herein. Flat face flanges shall be used to mate with cast iron, ductile iron, FRP, and plastic lined flanges.

All steel flanges shall conform to the design and manufacturing standards and the material specifications indicated in Article 15225.1.5.

15225.2.4.2 Not Used.

15225.2.5 Gaskets

Gaskets shall be furnished if so indicated on the attachment(s).

Unless otherwise specified, compressed fiber gaskets shall be used with flat face flanges and slip-on raised face flanges. Spiral wound gaskets shall be used with all raised face flanges other than slip-on flanges. Gaskets are not required for lined pipe-to-lined pipe connections unless otherwise recommended by the manufacturer. Gaskets containing asbestos are not acceptable.

15225.2.5.1 Compressed Fiber Gaskets. Compressed fiber gasket materials shall be suitable for a maximum working pressure of 600 psi and a maximum working temperature of 750° F. Gaskets shall be dimensioned to suit the contact facing. They shall be full faced for flat face flanges and shall extend to the inside edge of the bolt holes on raised face flanges. Gaskets for plain finished surfaces shall be not less than 1/16 inch thick and for serrated surfaces shall be not less than 3/32 inch thick.

15225.2.5.2 Spiral Wound Gaskets. Spiral wound gaskets shall be constructed of a continuous stainless steel ribbon wound into a spiral with nonasbestos filler between adjacent coils. The gasket shall be inserted into a steel gauge ring whose outside diameter shall fit inside the flange bolts properly positioning the gasket. The gauge ring shall serve to limit the compression of the gasket to the proper value. Compressed gasket thickness shall be 0.130 inch \pm 0.005 inch.

15225.2.5.3 Rubber Gaskets. Rubber gasket materials shall be cloth inserted sheet rubber. They shall be full face and 1/16 inch thick unless otherwise specified.

15225.2.6 Bolting

Flange bolting shall be furnished if so indicated on the attachments listed in Article 15225.1.8.

Alloy steel bolting shall be used for joining all steel flanges having a design pressure rating of Class 150 or greater, except steel slip-on flanges.

Carbon steel bolting shall be used for joining all other flanges including steel slip-on flanges.

Bolting for bolt diameters 1-3/4 inches and larger shall consist of threaded studs and two nuts. Bolting for bolt diameters less than 1-3/4 inches may be threaded studs and nuts or bolts and nuts. Bolts and nuts shall be heavy hexagonal heads conforming to the standards listed in Article 15225.1.4.

All bolting shall be cadmium plated in accordance with the material specifications indicated in Article 15225.1.5.

15225.2.7 Not Used

15225.2.8 Not Used

15225.2.9 Cleaning

Interior and exterior surfaces of all piping shall be thoroughly cleaned of sand, mill scale, greases, oils, dirt, and other foreign materials.

15225.2.9.1 Interior Cleaning. Interior surfaces of all piping shall be cleaned in accordance with the type of cleaning specified on the Pipeline List and as described in the applicable standards indicated in Article 15225.1.4.

Interior surfaces specified to be prepared in accordance with Cleaning Code STD require no special cleaning.

15225.2.10 Coatings

All carbon steel piping shall be coated as specified herein and in the Section 09900 with Supplemental Specifications in Section 01400. Stainless steel piping shall not be coated.

15225.2.10.1 Not Used.

15225.2.10.2 Exterior Surface Coatings. Piping exteriors, parts, and appurtenances shall be prepared and coated in accordance with the following.

All exposed surfaces shall be prime painted except for piping internals (including internal surfaces of branch connections), stainless steel, flange faces, threaded surfaces, external surfaces within 3 inches of field welded connections, and external surfaces of insulated pipe.

Piping shall be painted using the coating system that is specified on the drawings and in the Pipeline List. Painting shall be in accordance with Section 01400 and Section 09900.

15225.2.10.3 Weld End Coatings. Machined weld end preparations for field welds on carbon and alloy steel piping shall be coated with a weldable consumable coating as specified on the drawings and in the Pipeline List to prevent surface corrosion prior to welding.

15225.2.10.4 Flange Face/Threaded Connection Coating. Flange faces on shotblast cleaned pipe shall be given an application of a water soluble preservative coating as specified on the drawings and in the Pipeline List. Flange faces on piping cleaned by the pickling method shall be given an application of an oil soluble preservative coating as specified on the drawings and in the Pipeline List.

15225.2.11 Jointing Materials and Tools

Where specified in Article 15225.1.1.6, the Contractor shall furnish welding rod, flux, solvent cement, or any other consumable materials required for proper erection of the pipe and fittings furnished under these specifications. Welding rod and related materials shall be in accordance with the Supplemental Specifications in Section 01400. Solvent cement and related materials shall be in accordance with the recommendations of the manufacturer of the pipe with which they will be used.

The Contractor shall provide any special tools required for joining plastic or pressed fit pipe.

15225.2.12 Preparation for Shipment

Interior and exterior surfaces of piping and accessories shall be cleaned and shall have preservative coatings applied prior to shipment to the jobsite in accordance with the Supplemental Specifications in Section 01400.

Open ends and branches of piping shall be securely closed as follows to protect the interior cleanliness and end surfaces during shipment:

Weld end larger than 2 inches--Attach a plastic cap or metal cap lined in the end with 3/4 inch soft wood and seal with waterproof tape.

Female opening 2 inches and smaller, such as Sock-o-let--Press in a light metal or plastic insert and seal with waterproof tape.

Miscellaneous loose items shall be suitably packed in heavy wooden boxes with waterproof linings to prevent entry of dirt and moisture.

15225.3 Execution

Piping erection shall be in accordance with the requirements of Section 15921 - Pipe Erection.

15243 - Rubber Expansion Joints

15243.1 General

15243.1.1 Scope of Supply

Scope of supply shall include furnishing the rubber expansion joints indicated as follows:

ID Number	Description	Nominal Size/ End-to-end Dimensions	Max Trans-verse Movement	Operating Pressure/ Design Pressure	Operating Temperature/ Design Temperature	Manu- facturer and Model Number	Remarks
CWSH-EXJ-1	Demineralized Water Storage Tank Suction Connection	8 in/ 13 in	1.375 in	70 psig/ 100 psig	70 °F/ 105 °F	Proco Model 242, or equal	Transverse deflection is min +/- value; neoprene rubber; double arch with control rods

15243.1.2 Not Used

15243.1.3 Performance and Design Requirements

Performance and design requirements for the metallic expansion joints are covered in Section 15243.1.1.

15243.1.4 Codes and Standards

Work performed under these specifications shall be done in accordance with the following codes and standards. Unless otherwise specified, the applicable governing edition and addenda to be used for all references to codes or standards specified herein shall be interpreted to be the jurisdictionally approved edition and addenda. If a code or standard is not jurisdictionally mandated, then the current edition and addenda in effect at the date of this document shall apply. These references shall govern the work except where they conflict with the Engineer's specifications. In case of conflict, the latter shall govern to the extent of such difference:

Work	In Accordance With
Design and construction of expansion joints	Technical Handbook for the Rubber Expansion Joint Division of the Fluid Sealing Association ANSI ASTM ASME OSHA - Occupational Safety and Health Administration Standards
Facing and drilling of flanges for expansion joints larger than 96 inches and for joints not covered by ANSI standards	AWWA C207

Work	In Accordance With
Facing of all other flanges	Technical Handbook for the Rubber Expansion Joint Division of the Fluid Sealing Association

15243.1.5 Materials

The following materials shall be used:

Component	Material
Retaining rings	Galvanized carbon steel or 316 stainless steel
Nuts and washers for control rods	Carbon steel, ASTM A307 or 316 stainless steel
Control rods	Galvanized carbon steel, ASTM A307 or 316 stainless steel
Elastomer	Synthetic rubber containing no polyisoprenes, neoprene or other
Control rod plate	Galvanized carbon steel or 316 stainless steel
Compression sleeve	Galvanized carbon steel or 316 stainless steel

15243.1.6 Approved Manufacturers of Components

For the following components, only the listed manufacturers are recognized as maintaining the level of quality of workmanship required by these specifications. If the Contractor wants to propose a nonlisted manufacturer that is considered to provide an equivalent level of quality, this manufacturer must be identified and supporting testimony provided. Acceptance of the manufacturer as a substitute is at the discretion of the Engineer:

Component	Manufacturer

15243.1.7 Test Requirements

The following testing shall be conducted in accordance with the specified source. This testing is to be considered part of the defined Scope of Work, and all associated costs are the responsibility of the Contractor:

Tests	In Accordance With	Conducted By
Field Hydrostatic Test	1.5 times the design pressure	Contractor

15243.1.8 Technical Attachments

Technical attachments relevant to the work under this section are listed in Section 01100.

15243.1.9 Supplemental Specifications

Technical supplemental specifications that are applicable to the work covered under this technical specification section are identified and included in Section 01400.

15243.2 Products

15243.2.1 Type

Expansion joints shall be of the spool type with right angle full faced flanges of reinforced rubber and fabric with metal retaining rings.

15243.2.2 Design Conditions

Expansion joints shall be designed for the services described in Section 15243.1.1 including end-to-end dimensions, pressures, temperatures, and movements. Designs shall be adequate to prevent excessive stresses in expansion elements or excessive reaction forces in the piping systems. Expansion movements specified represent the distances through which the joint may be required to act in either direction from joint neutral position.

Expansion joints for which vacuum service is specified shall be suitable for vacuum to minus 30 inches of mercury.

15243.2.3 Construction

Expansion joints shall be furnished with U-shaped elements constructed from multiple layers of heavy duck impregnated with rubber and reinforced with steel rings. Exposed edges of rubber in bolt holes shall be coated with self-vulcanizing rubber to protect cotton duck from deterioration.

Control units shall be furnished to prevent excessive expansion joint elongation when specified on the attached Mechanical Device List - Rubber Expansion Joints. The minimum number of control rods shall be as necessary to withstand forces resulting from 1-1/2 times the design pressure listed in Section 15243.1.1.

15243.2.4 Testing

Expansion joints will be hydrostatically tested after installation at 1-1/2 times the design pressure listed in Section 15243.1.1.

No leakage will be permitted. The Contractor shall repair or replace joints that are not accepted at the conclusion of this field testing. All costs associated with repair or replacement, including, but not limited to, removal, shipping, express repair, and replacement, shall be to the Contractor's account.

15243.2.5 Protection

Expansion joints shall be shipped with compression sleeves and control rods to protect the joints during shipment, handling, hydrostatic testing, and normal operation.

15243.2.6 Shop Coatings

A neoprene covering with a coating that is not adversely affected by sunlight or weathering shall be provided for exterior surfaces of expansion joints.

15243.3 Execution

Not Used.

15263 - General Service Valves

15263.1 General

15263.1.1 Scope of Supply

Scope of supply shall include furnishing the general service valves required by the Contractor's equipment or system design.

15263.1.2 Not Used

15263.1.3 Performance and Design Requirements

Performance and design requirements for general service valves are as follows:

VALVE LIST					
VALVE TAG NUMBER	ABBREVIATED DESCRIPTION	VALVE TYPE/ SIZE-IN-OUT	VLV CLASS/BODY MATERIAL/END PREP	DESIGN PRESSURE/DESIGN TEMPERATURE/ FLUID	REMARKS
CFOA-BV-1	Fuel oil storage tank 1 suction isolation	Ball 8 in	CL 150 CS FLANGE	150 PSI 105 F Fuel Oil	Fire safe design that meets API 607
CFOA-BV-2	Fuel oil storage tank 1 suction fusible link valve	Special 8 in	CS FLANGE	150 PSI 105 F Fuel Oil	Oceco V114 or equal. Internal tank shutoff valve with fusible link
CFOA-BV-3	Fuel oil storage tank 1 recirc isolation	Ball 6 in	CL 150 CS FLANGE	150 PSI 105 F Fuel Oil	Lock open. Fire safe design that meets API 607
CFOA-BV-4	Fuel oil storage tank 1 fusible link valve	Special 6 in	CL 150 CS FLANGE	150 PSI 105 F Fuel Oil	Oceco V114 or equal. Internal tank shutoff valve with fusible link
CFOA-BV-5	Fuel oil storage tank 1 fill isolation	Ball 8 in	CL 150 CS FLANGE	60 PSI 105 F Fuel Oil	Fire safe design that meets API 607
CFOA-BV-6	Fuel oil storage tank 1 fusible link valve	Special 8 in	CL 150 CS FLANGE	150 PSI 105 F Fuel Oil	Oceco V114 or equal. Internal tank shutoff valve with fusible link
CFOA-BV-7	Fuel oil storage tank 1 spare connection isolation	Ball 8 in	CL 150 CS FLANGE	60 PSI 105 F Fuel Oil	Fire safe design that meets API 607
CFOA-BV-8	Fuel oil storage tank 1 spare fusible link valve	Special 8 in	CL 150 CS FLANGE	150 PSI 105 F Fuel Oil	Oceco V114 or equal. Internal tank shutoff valve with fusible link
CFOA-BV-9	Fuel oil storage tank 1 spare connection isolation	Ball 8 in	CL 150 CS FLANGE	60 PSI 105 F Fuel Oil	Fire safe design that meets API 607

**JEA GEC FUEL
OIL/DEMINERALIZED
WATER STORAGE TANK
ADDITION
196116.70.0100**

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GENERAL CONTRUCTION

July 26th, 2017

CFOA-BV-10	Fuel oil storage tank 1 spare fusible link valve	Special 8 in	CS FLANGE	150 PSI 105 F Fuel Oil	Oceco V114 or equal. Internal tank shutoff valve with fusible link
CFOA-BV-11	Fuel oil storage tank 2 suction isolation	Ball 8 in	CL 150 CS FLANGE	150 PSI 105 F Fuel Oil	Fire safe design that meets API 607
CFOA-BV-12	Fuel oil storage tank 2 spare fusible link valve	Special 8 in	CS FLANGE	150 PSI 105 F Fuel Oil	Oceco V114 or equal. Internal tank shutoff valve with fusible link
CFOA-BV-13	Fuel oil storage tank 2 recirc isolation	Ball 6 in	CL 150 CS FLANGE	150 PSI 105 F Fuel Oil	Fire safe design that meets API 607
CFOA-BV-14	Fuel oil storage tank 2 fusible link valve	Special 8 in	CL 150 CS FLANGE	150 PSI 105 F Fuel Oil	Oceco V114 or equal. Internal tank shutoff valve with fusible link
CFOA-BV-15	Fuel oil storage tank 2 fill isolation	Ball 8 in	CL 150 CS FLANGE	60 PSI 105 F Fuel Oil	Fire safe design that meets API 607
CFOA-BV-16	Fuel oil storage tank 2 fusible link valve	Special 8 in	CL 150 CS FLANGE	150 PSI 105 F Fuel Oil	Oceco V114 or equal. Internal tank shutoff valve with fusible link
CFOA-BV-17	Fuel oil storage tank 2 spare connection isolation	Ball 8 in	CL 150 CS FLANGE	60 PSI 105 F Fuel Oil	Fire safe design that meets API 607
CFOA-BV-18	Fuel oil storage tank 2 spare fusible link valve	Special 8 in	CS FLANGE	150 PSI 105 F Fuel Oil	Oceco V114 or equal. Internal tank shutoff valve with fusible link
CFOA-BV-19	Fuel oil storage tank 2 spare connection isolation	Ball 8 in	CL 150 CS FLANGE	60 PSI 105 F Fuel Oil	Fire safe design that meets API 607
CFOA-BV-20	Fuel oil storage tank 2 spare fusible link valve	Special 8 in	CS FLANGE	150 PSI 105 F Fuel Oil	Oceco V114 or equal. Internal tank shutoff valve with fusible link
CFOA-BV-21	Fuel oil storage tanks biocide injection connection isolation	Ball 1 in	CL 600 CS SWLD	150 PSI 105 F Fuel Oil	Fire safe design that meets API 607
CWSH-BV-1	Demin water transfer pump suction storage tank isolation	Butterfly 8 in	CL 150 CI LUG WF	100 PSI 105 F Demin Water	EPDM lined with nylon coated disc

CWSH-BV-2	Demin water transfer pump suction future storage tank isolation	Butterfly 8 in	CL 150 CI LUG WF	100 PSI 105 F Demin Water	EPDM lined with nylon coated disc
CWSH-BV-3	Demin water transfer pump suction header isolation	Butterfly 8 in	CL 150 CI LUG WF	100 PSI 105 F Demin Water	EPDM lined with nylon coated disc
CWSH-BV-4	Demin water surge tank fill header isolation	Butterfly 6 in	CL 150 CI LUG WF	100 PSI 105 F Demin Water	EPDM lined with nylon coated disc
CWSH-BV-5	Demin water storage tank fill header isolation	Butterfly 6 in	CL 150 CI LUG WF	100 PSI 105 F Demin Water	EPDM lined with nylon coated disc
CWSH-BV-6	Future demin water storage tank fill isolation	Butterfly 6 in	CL 150 CI LUG WF	100 PSI 105 F Demin Water	EPDM lined with nylon coated disc
CWSH-BV-7	Demin water storage tank fill isolation	Butterfly 6 in	CL 150 CI LUG WF	100 PSI 105 F Demin Water	EPDM lined with nylon coated disc
CWSH-BV-8	Demin water transfer pump return surge tank isolation	Butterfly 3 in	CL 150 CI LUG WF	100 PSI 105 F Demin Water	EPDM lined with nylon coated disc
CWSH-BV-9	Demin water transfer pump return header isolation	Butterfly 4 in	CL 150 CI LUG WF	100 PSI 105 F Demin Water	EPDM lined with nylon coated disc
CWSH-BV-10	Demin water transfer pump return future storage tank isolation	Butterfly 4 in	CL 150 CI LUG WF	100 PSI 105 F Demin Water	EPDM lined with nylon coated disc
CWSH-BV-11	Demin water transfer pump return storage tank isolation	Butterfly 4 in	CL 150 CI LUG WF	100 PSI 105 F Demin Water	EPDM lined with nylon coated disc
CWSH-BV-12	Demin water storage tank LT isolation	Ball 2 in	CL 150 CI SWLD	100 PSI 105 F Demin Water	
CWSH-BV-13	Demin water storage tank spare connection isolation	Butterfly 8 in	CL 150 CI LUG WF	100 PSI 105 F Demin Water	EPDM lined with nylon coated disc
CWSH-BV-14	Demin water storage tank drain isolation	Butterfly 4 in	CL 150 CI LUG WF	100 PSI 105 F Demin Water	EPDM lined with nylon coated disc

CWWC-BV-1	Fuel oil storage tank containment area drain valve	Gate 8 in	250 WWP DI MEC JT	30 PSI 105 F Wastewater	Non rising stem AWWA C515 gate with post indicator
CWWC-BV-2	Fuel oil storage tank containment area drain valve	Gate 8 in	250 WWP DI MEC JT	30 PSI 105 F Wastewater	Non rising stem AWWA C515 gate with post indicator

15263.1.4 Codes and Standards

Work performed under these specifications shall be done in accordance with the following codes and standards. Unless otherwise specified, the applicable governing edition and addenda to be used for all references to codes or standards specified herein shall be interpreted to be the jurisdictionally approved edition and addenda. If a code or standard is not jurisdictionally mandated, then the current edition and addenda in effect at the date of this document shall apply. These references shall govern the work except where they conflict with the Owner's specifications. In case of conflict, the latter shall govern to the extent of such difference:

Work	In Accordance With
Construction of all valves and accessories	ASME Power Piping Code, B31.1
Construction of all steel body valves	ANSI B16.34
Face-to-face and end-to-end dimensions of steel valves 2-1/2 inches and larger and all iron body valves	ANSI B16.10
Sizing of bypasses and drains	MSS SP-45
Indicator Posts	NFPA 24, UL 789

15263.1.5 Materials

To demonstrate the acceptability of the metallurgical properties of each casting furnished as a pressure retaining component and with a design temperature greater than 210°F, each casting shall be furnished with one of the following: either a Certified Material Test Report (CMTR) which demonstrates an aluminum content not exceeding 0.08 percent, or documentation demonstrating compliance with ASTM A703 S23 requirements.

15263.1.6 Approved Manufacturers of Components

For the following components, only the listed manufacturers are recognized as maintaining the level of quality of workmanship required by these specifications. If the Contractor wants to propose a nonlisted manufacturer that is considered to provide an equivalent level of quality, this manufacturer must be identified and supporting testimony provided. Acceptance of the manufacturer as a substitute is at the discretion of the Engineer:

Component	Manufacturer
Forged steel valves	Bonney Forge, Conval, Crane, Dresser-Hancock, Edward, Grinnell, Newco, Raimondii, RP&C, Velan, Walthon Weir Pacific, Whitey (globe valves)

Component	Manufacturer
Cast steel valves	American Energy Services, Atwood/Tricentric, Cooper, Crane, Edward, Grinnell, Grove, Newco, Pacific, Powell, Stockham, Velan, Wheatley
Butterfly valves	BIF, Crane, DeZurik, Dow, Dresser, McCanna, Bray, Keystone, Saunders
Cast iron valves	Anchor/Darling, Crane, Grinnell, KLM, Newco, Nibco
Ball valves	Apollo, Dow, Grove, Hayward, McCanna, KTM, Neles-Jamesbury, Nibco, Velan
Check valves	Consolidated, Dow, Nupro, Stockham, Wheatley
Ductile iron gate valves	ACIPCO, American AVK, M&H, Mueller
Post Indicators	ACIPCO, American AVK, M&H, Mueller
Fusible Link/Thermal Shut-off Fire Safety Valves	Fisher, OCECO, Protectoseal, Shand & Jurs

15263.1.7 Test Requirements

The following testing shall be conducted in accordance with the specified source. This testing is to be considered part of the defined Scope of Work, and all associated costs are the responsibility of the Contractor:

Tests	In Accordance With	Conducted By
Hydrostatic shell and seat leakage tests required by the referenced standard	ANSI B16.34	Contractor or valve manufacturer
Total Aluminum Content	15263.1.5 herein	Contractor or valve manufacturer
Radiographic Examination	15263.1.7.1	Contractor or valve manufacturer

15263.1.7.1 Radiographic Examination Requirements. The table below indicates where radiographic examination shall be performed on castings in accordance with the requirements in ASME B16.34, Paragraph 8.3.1.1(a)(1). In addition, any components which contain a hazardous or flammable/combustible fluid shall also be inspected in accordance with these requirements. Any defects found in these examinations shall be documented in a Non-Conformance Report and submitted to the Owner prior to repair or acceptance of the affected casting part.

Size - NPT	Press. Class	Design Temp	NDE Sample	Acceptance Criteria
>2"	All	>=750F	100%	B16.34, Para 8.
>2"	>300#	>=350F	100%	B16.34, Para 8.

15263.1.8 Technical Attachments

Technical attachments relevant to the work under this section are listed in Section 01100.

15263.1.9 Supplemental Specifications

Technical supplemental specifications that are applicable to the work covered under this technical specification section are identified and included in Section 01400.

15263.2 Products

15263.2.1 General

This article covers the requirements for gate, globe, butterfly, and ball valves to be furnished under these specifications.

All check valves shall be designed for installation in either horizontal piping or vertical piping with upward flow.

15263.2.2 Steel Body Gate and Globe Valves

15263.2.2.1 Steel Body Valves 2 Inches and Smaller. Steel body valves 2 inches and smaller shall have forged steel bodies.

15263.2.2.2 Steel Body Valves 2-1/2 Inches and Larger. Steel body valves 2-1/2 inches and larger shall have cast steel bodies. Valve ends shall be butt weld type unless otherwise specified.

Valve bodies and bonnets shall be designed to support the valve operators (handwheel, gear, electric actuator, or pneumatic actuator) with the valve in any position and without external support.

When both a drain and a bypass are to be provided on the same main valve, a drain valve shall connect to the piping between the two bypass valves to permit independent drainage of both sides of the main valve.

Bypass valves, drain valves, and piping shall have pressure-temperature ratings equal to or exceeding those of the main valve and shall be constructed of materials equivalent to the main valve.

Pipe for bypasses and drains shall be seamless and shall not be lighter than Schedule 80. Fittings and valves shall be welded type.

15263.2.3 Butterfly Valves

Butterfly valves shall be of the heavy-duty short body type with rubber seats and shall provide bubbletight shutoff.

Valves and operators shall be suitable for the application in conjunction with any piping configuration. Valves to be installed in horizontal piping shall be designed so that with the valve shaft horizontal, the bottom of the disk opens in the direction of flow. Valves shall be designed to accommodate the weight of the operator without allowing deflection or overloading of the valve shaft with the shaft oriented in any position.

Valve shafts shall be designed and machined such that no significant stress risers exist at transitions in diameter or cross section. Shafts shall be suitable for repeated application of 300 pounds force lateral and/or axial load from plant operators applied at the extreme distance without damage, including fatigue, bending, shear, or yielding.

Assembled valves shall be capable of withstanding, without leakage, a hydrostatic pressure test at 100° F (38° C), in the open or closed position, at a test pressure of 1.5 times the valve pressure class maximum rating.

Valve disks shall rotate approximately 90 degrees from full open to tight shutoff position.

Where required for the application, all surfaces of the valve body, disk, and other components exposed to the fluid shall be coated or rubber lined.

15263.2.4 Not Used

15263.2.5 Iron Body Gate Valves

Iron body valves shall be "ibbm" (iron body bronze mounted). Ductile iron body gate valves shall conform to AWWA C515.

15263.2.6 Not Used

15263.2.7 Ball Valves

All ball valves shall have full area ports, teflon seats and seals, and chrome plated carbon steel or stainless steel balls. The valves shall not require lubrication. Operating wrenches shall be provided on each valve.

All ball valves in fuel handling service shall be of fire safe design and use secondary metal seating surfaces to ensure shutoff if the teflon seats are destroyed by fire.

15263.2.8 Not Used

15263.2.9 Not Used

15263.2.10 Special Features

Special features such as locking devices, valve boxes and handwheel extensions, limit switches, vacuum service, boiler code, and UL/FM rating shall be furnished as required by the design.

15263.2.10.1 Not Used.

15263.2.10.2 Not Used.

15263.2.10.3 Handwheels. Handwheels shall be selected to limit the normal operating forces to less than 80 pounds and the seating/unseating forces to less than 120 pounds at the rim of the handwheel. Handwheels shall not exceed 24 inches outside diameter.

15263.2.10.4 Locking Devices. Locking devices shall allow the valve to be locked in either the open or closed position by use of a standard padlock.

15263.2.10.5 Handwheel Extensions. Handwheel extensions shall be provided as required for reasonable ease of manual valve operation by plant personnel.

15263.2.10.6 Limit Switches. Limit switches shall be as specified in Section 01400.

15263.2.10.7 Not Used.

15263.2.10.8 Not Used.

15263.2.10.9 Underwriters Laboratories Inc. Listed and Factory Mutual Approved. Where required by the design, valves shall be Underwriters Laboratories Inc. (UL) listed and Factory Mutual (FM) approved.

15263.2.11 Installation Instructions

If field erection is not part of the scope of this Contract, installation instructions for installing any valves shipped loose shall be provided. The instructions shall state valve plug or disk position during joining operations, disassembly requirements, and all other precautions, recommendations, or special instructions for proper installation.

15263.2.12 Identification

Owner Identification requirements are specified in Supplemental Section Q400.

15263.3 Execution

Valves shall be installed in accordance with the requirements of Section 15921 – Piping Erection.

15901 - Mechanical Equipment Erection

15901.1 General

This section covers the general erection requirements for all mechanical equipment to be erected by the Contractor. When applicable, additional detailed requirements for erection of specific items of equipment are covered in separate sections as listed in Article 15901.1.3.

15901.1.1 Scope of Work

Equipment erection shall include all work required for complete installation, from unloading to placing the equipment in successful operation.

15901.1.2 Scope Responsibilities

The following items shall be furnished by the Contractor or will be furnished by the Owner as indicated:

Item	By Contractor	By Owner
Concrete equipment bases	X	
Anchor bolts and pipe sleeves cast into concrete equipment bases	X	
Post-installed mechanical anchors for equipment that will not have cast-in-place anchor bolts	X	
Grouting materials	X	
Shims and wedges	X	
Dowels	X	
Anchors and supports	X	
Bolting for structural attachments	X	
Bolting for connecting pipe flanges to flanged equipment connections	X	
Gaskets	X	
Packing	X	
Welding rod	X	
Consumable gases	X	
All other miscellaneous materials required for complete erection of the equipment	X	

15901.1.3 Detailed Erection Requirements

Additional detailed requirements for erection of some equipment items are covered in the following sections:

03311 - Cast-in-Place Concrete.

03611 - Grouting.

09900 - Field Applied Protective Coatings.

15921 - Piping Erection.

15901.1.4 Codes and Standards

Work performed under these specifications shall be done in accordance with the following codes and standards. Unless otherwise specified, the applicable governing edition and addenda to be used for all references to codes or standards specified herein shall be interpreted to be the jurisdictionally approved edition and addenda. If a code or standard is not jurisdictionally mandated, then the current edition and addenda in effect at the date of this document shall apply. These references shall govern the work except where they conflict with the Owner's specifications. In case of conflict, the latter shall govern to the extent of such difference:

Work	In Accordance With
Equipment Erection	ASME B31.1 Code for Pressure Piping ASME Boiler and Pressure Vessel Code

15901.1.5 Materials

The following materials shall be used:

Component	Material
Bolting for structural attachments	ASTM A490
Bolting for pipe connection flanges	In accordance with Section 15921
Post-installed mechanical anchor bolts	Hilti Kwik-Bolt TZ or acceptable equal meeting Federal Specification A-A-1923A, Type 4, IBC, and ACI 318, Appendix D

15901.1.6 Not Used

15901.1.7 Not Used

15901.1.8 Technical Attachments

Technical attachments relevant to the work under this section are listed in Section 01100.

15901.1.9 Supplemental Specifications

Technical supplemental specifications that are applicable to the work covered under this technical specification section are identified and included in Section 01400.

15901.2 Products

Not applicable.

15901.3 Execution

15901.3.1 General

Erection procedures shall be in accordance with the recommendations of the equipment manufacturers. If requirements contained herein are in conflict with equipment manufacturer requirements, the issue shall be referred to the Owner for resolution.

Equipment shall be checked prior to its installation to ensure that it is in conformance with the manufacturer's drawings. Any discrepancies shall be reported to the Engineer.

When equipment to be erected by the Contractor is shipped unassembled, the complete assembly of such equipment shall be a part of the work included under these specifications.

If the equipment to be erected by the Contractor includes equipment that has electrical connections, the electrical connection work will be covered in other sections of these specifications. Setting and all other erection work for this equipment shall be performed under this section.

15901.3.2 Code Requirements

All erection procedures shall be in conformance with accepted good engineering practice, the latest applicable requirements of the codes and standards listed in Article 15901.1.4, and all relevant laws and local regulations.

15901.3.3 Location Tolerances

All equipment shall be located within 1/8 inch of the dimensioned locations indicated on the drawings.

15901.3.4 Piping Connections

All equipment that has piping connections shall be leveled, aligned, and shimmed in place and shall have piping initially fit before being grouted, except as approved by the Engineer. Equipment shall be grouted or bolted to its foundation prior to final bolting or welding of the connecting piping.

15901.3.5 Not Used

15901.3.6 Equipment Piping

All piping, valves, and fittings furnished with the equipment shall be installed in accordance with the requirements of Section 15921.

15901.3.7 Not Used

15901.3.8 Welding

When welding to equipment that is assembled, separate ground leads shall be attached to the equipment, pipes, or components to prevent stray welding currents from arcing the internals of the equipment. Wherever possible, the ground lead shall be 2/0 AWG cable or larger, directly and mechanically connected adjacent to the welding area, and returned directly to the welding power source.

15901.3.9 Not Used

15901.3.10 Not Used

15901.3.11 Equipment Checkout

All equipment shall be cleaned.

15901.3.12 Miscellaneous Equipment

Miscellaneous equipment such as fire hose and racks, locally mounted pressure and flow transmitters, pilot controls for control valves, and similar items shall be installed in locations in accordance with the drawings if shown. Such items not shown on the drawings shall be installed in easily accessible locations and subject to the acceptance of the Engineer. All such items shall be rigidly supported from the structure by means of suitable brackets.

15901.3.13 Defects

All defects in erection shall be corrected to the satisfaction of the Engineer. The dismantling and reassembly of Contractor-furnished equipment to remove defective parts, replace parts, or make adjustments shall be included as a part of the work under these specifications.

15901.3.14 Maintenance Tools

Except as otherwise specified, all tools purchased with equipment for maintenance purposes shall not be used for erection purposes. All such tools shall be stored as directed by the Owner.

15921 - Piping Erection

15921.1 General

15921.1.1 Scope of Work

The work shall include erection of all piping, fittings, valves, supports, and piping specialties, as called for on the drawings and specifications, and by the codes and standards. Erection of piping systems designated by the system codes and indicated on the drawings listed in Article 15921.1.8 are included, except as otherwise specified herein. The Contractor shall furnish all required materials and perform all related work for completion of the work included under these specifications.

If furnishing any piping or fittings; trenching, and earthwork for underground piping; or furnishing and/or installing control and instrument piping is included in the Scope of Work, it shall be done in accordance with separate sections included in these specifications:

Additional Scope	The additional Scope of Work for this package includes the following items:	
System Name	System Code	Category*
Fuel Oil Supply & Storage	FOA	2
Demin Water NOx Injection Supply & Storage	WSH	2
Fuel Oil Fire Protection	FPA	2
Fuel Oil Containment Area Drain	WWC	
*Categories are as follows: 1. Noncold sprung critical piping system. 2. Noncritical piping system.		
The systems listed above include the following:		
Above grade piping	Yes	
Below grade piping	Yes	
In addition to erection of the piping systems defined above, the Scope of Work includes the following services and materials:		
Routing of miscellaneous 2 inch (50 mm) and smaller pipe, fittings, and valves	Yes	
Installation of instrument and control piping and tubing as indicated on the attachments	Yes	
Hydrostatic testing of piping erected under these specifications	Yes	

Fuel Oil flush cleaning	Yes
Scope	Flushing of fuel oil piping
Demineralized Water flush cleaning	Yes
Scope	Flushing of demineralized water piping
Furnish and install pipeline identification	Yes
Stencil	Yes

15921.1.2 Not Used

15921.1.3 Not Used

15921.1.4 Codes and Standards

Work performed under these specifications shall be done in accordance with the following codes and standards. Unless otherwise specified, the applicable governing edition and addenda to be used for all references to codes or standards specified herein shall be interpreted to be the jurisdictionally approved edition and addenda. If a code or standard is not jurisdictionally mandated, then the current edition and addenda in effect at the date of this document shall apply. These references shall govern the work except where they conflict with the Owner's specifications. In case of conflict, the latter shall govern to the extent of such difference:

Work	In Accordance With
Installation of mechanical joint piping	ANSI/AWWA C111/A21.11
Repair of damaged shop applied coatings for underground piping	AWWA C203
Dimensions and installation of restrained push-on type joints	AWWA C606

15921.1.5 Materials

The following materials shall be used:

Component	Material
Flexible weatherproofing	Nylon reinforced neoprene fabric with compatible adhesive
Clamps for attaching flexible weatherproofing to pipe and sleeve	Stainless steel worm drive clamps
Nonfire rated penetration seals	Nylon reinforced hypalon with closure zipper and stainless steel worm drive clamps
Field applied protective coating for underground pipe	Tape and primer system
Metal pipe identification signs	Aluminum sheet, No. 5005 H-16, with engraved legends filled with paint

Component	Material
Pipe identification labels	Pressure sensitive vinyl cloth

15921.1.6 Acceptable Manufacturer's

For the following components, only the listed manufacturers are recognized as maintaining the level of quality of workmanship required by these specifications. If the Contractor wants to propose a nonlisted manufacturer that is considered to provide an equivalent level of quality, this manufacturer must be identified and supporting testimony provided. Acceptance of the manufacturer as a substitute is at the discretion of the Owner:

Component	Manufacturer
Flexible weatherproofing fabric and adhesive	DuPont (Fairprene 5798 material with Fairprene 5128 adhesive)
Clamps for attaching flexible weatherproofing to pipe and sleeve	Aero-Seal (QS 200)
Field applied protective coating for underground pipe	Tapecoat (CT 10/40W with moldable sealant to prime and fill voids)
Shrink sleeves for underground piping	Raychem Corporation
Pipe identification labels	Brady Corporation (Type B500)

15921.1.7 Test Requirements

The following testing shall be conducted in accordance with the specified source. This testing is to be considered part of the defined Scope of Work, and all associated costs are the responsibility of the Contractor:

Tests	In Accordance With	Conducted By
Hydrostatic and pneumatic testing of piping	ASME B31.1, Paragraph 137	Contractor
Hydrostatic testing of underground fire protection piping	NFPA 24	Contractor
Pressure testing of nonmetallic piping	ASME B31.1, Paragraph 137; and as supplemented by Article 15921.3.29	Contractor
Holiday testing of shop applied coatings for underground pipe	AWWA C203	Contractor
Holiday testing of field applied coatings for underground pipe	Coating manufacturer's recommendations	Contractor
Holiday testing of field installed shrink sleeves for underground piping	Manufacturer's recommendations	Contractor

Tests	In Accordance With	Conducted By
Testing of electrical isolation flange kits	Manufacturer's recommendations	Contractor

15921.1.8 Technical Attachments

Technical attachments relevant to the work under this section are listed in Section 01100.

15921.1.9 Supplemental Specifications

Technical supplemental specifications that are applicable to the work covered under this technical specification section are identified and included in Section 01400.

15921.2 Products

15921.2.1 Pipeline List

The Pipeline List and piping drawings included with these specifications detail the requirements for the various major piping systems to be erected under these specifications.

The information included on the Pipeline List and/or piping drawings designates the pipeline identification number; line description; operating, design, and test pressures and temperatures; pipe material, nominal sizes, and corresponding schedule or wall thickness; valve class rating, end preparation requirements, and material; insulation class; welding remarks; gasket types; and special features.

15921.3 Execution

All piping, valves, fittings, and piping specialties shall be erected in accordance with the requirements of this section. Any piping installation not specified herein shall be done in accordance with good engineering practice.

The drawings indicate the dimensions of the major lines. These dimensions are subject to change to accommodate the equipment, valves, and fittings actually furnished and the variations in equipment as actually installed. If the equipment, valves, fittings, and other components of the piping systems actually furnished differ in dimensions from those indicated, the piping systems shall be altered as required to accommodate these changes. If, due to some unforeseen circumstance, the installation of the piping as indicated would result in an interference, the modifications or corrections required to install the piping free from interferences shall be made.

A field check of all connections to equipment and existing pipe, valves, or fittings for location, size, butt weld end preparation or flange drilling and facing shall be made prior to erecting interconnecting piping.

Allowances in fit-up and modifications to piping spools shall be made as required prior to completion of field welds and hoisting pipe spools into place as applicable.

Pipe, fittings, valves, and accessories shall be handled in a manner that will ensure installation in a sound, undamaged condition. Equipment, tools, and methods used in unloading, reloading, hauling, and laying pipe and fittings shall be such that the pipe and fittings are not damaged.

Particular care shall be taken to prevent damage to protective coatings and concrete pipe joint rings. Slings shall be nonabrasive and located between the ends of each pipe section when lifting. Bare wire rope slings or the use of hooks to lift pipe will not be permitted.

15921.3.1 Welding

Field welding shall be in accordance with the requirements of the Supplemental Specifications in Section 01400.

15921.3.2 Miscellaneous Piping

Miscellaneous piping is defined as piping 2 inches and smaller which is not shown on the detailed piping drawings. All miscellaneous piping shall be routed and installed in a neat, rectangular form. Special attention shall be given to securing a neat appearance. All piping shall be installed perpendicular or parallel to the major equipment, building structure, and floor levels except in special cases consented to by the Engineer.

If routing of miscellaneous piping is included under these specifications, all piping, including tubing, not located on the drawings shall be routed and installed in accordance with the following requirements:

Pipe routing shall allow unobstructed maintenance of plant equipment.

Piping shall not be installed above, or within a horizontal distance of 3 feet from, electrical equipment such as switchgear, switchboards, control panels, motor controls, contactors, communication equipment, batteries, battery chargers, and motor generators unless written consent of the Engineer is obtained. Improperly located piping shall be removed and relocated.

All branch piping shall be provided with shutoff valves at the main headers.

Valves shall be installed in such a manner that they can be operated from the main operating floors or platforms without the use of ladders or special operating devices.

Piping shall be installed with a minimum of 7'-6" headroom over passageways and walkways.

Routings shall be selected to avoid interference with planned and dimensioned locations for lighting fixtures, electrical trays, raceways, or conduit. The Contractor shall review the Owner's drawings for electrical construction to avoid such interferences before routing the piping.

Sketches of the proposed routing of all piping not located on the drawings shall be submitted to the Engineer. The Owner's acceptance of all routings shall be obtained before the piping is erected.

15921.3.2.1 Vents and Drains. Vents and drains for system filling and draining may not be shown on the drawings for miscellaneous pipe. The Contractor shall furnish and erect all required vents and drains to allow miscellaneous piping to be filled and drained. Each vent and drain shall be sized and shall include a shutoff valve and a screwed cap in accordance with the vents and drains shown on the associated P&ID for piping 2-1/2 inches and larger. All piping and fittings for vents and drains shall be provided in accordance with the Pipeline List.

15921.3.3 Not Used

15921.3.4 Piping in Existing Areas

Before installation of piping in existing areas, the routings of new piping to be installed shall be walked down to verify that the piping, insulation, and supports can be installed as designed without interference. If the piping as designed would interfere with existing facilities, the pipe routing shall be reviewed with the Engineer and shall then be altered or existing piping shall be relocated. All pipe routings shall be subject to acceptance by the Engineer.

15921.3.5 Alterations and Cut-ins

All alterations and cut-ins to existing piping and equipment indicated on the drawings shall be made as specified herein and as required for proper installation of the new piping and equipment.

All cut-ins shall be done by sawing, machining, or careful flame cutting as directed by the Engineer. Flame cut holes shall be ground smooth. The interior of the piping shall be thoroughly cleaned after cutting.

Whether indicated on the drawings or not, existing miscellaneous piping shall be revised as required to permit installation, without interference, of new piping and equipment. Existing miscellaneous piping that interferes with walkways or presents an unsightly appearance after modification of existing structures, equipment, or piping shall be relocated as directed by the Engineer. The alterations to existing piping shall include any required revisions, additions, or replacements of insulation and pipe supports.

Any piping materials and valves removed and not reused shall be disposed of as directed by the Owner.

All alterations and cut-ins to existing systems shall be made on a time schedule acceptable to the Owner.

After alterations and cut-ins to existing coated equipment or coated piping have been made, the damaged coating shall be repaired. All welds and sharp edges shall be finished smooth and all weld spatter shall be removed. The metal shall be prepared and the coating system applied in strict accordance with the instructions and recommendations of the coating manufacturer.

15921.3.6 Thermal Expansion

All piping shall be installed so that excessive or destructive expansion forces will not exist either in the cold condition or under conditions of maximum temperature.

15052.3.6.1 Critical Piping Systems. Not used.

15921.3.6.2 Noncritical Piping Systems. The Contractor shall install the pipe in a stress free condition. Cold spring shall not be used to close the final joint in runs of piping between equipment and anchors. The methods used to erect the piping shall result in an installation which is true to plan.

Where expansion joints are indicated on the drawings, anchors shall be installed as required to prevent damage from the forces generated by the fluid pressure of the line. Care must be taken in installing expansion joint anchors to make certain that full design movement is allowed at all times from maximum to minimum temperatures.

15921.3.7 Pipe Supports

The support assemblies shall not be used for the attachment of rigging to hoist the pipe into place. The piping shall be securely held in place by other means until the pipe support is completely assembled and attached to the pipe and building structures and the spring support set to take care of pipe sway. All rigging shall be removed in such a manner as not to impose a sudden load on the pipe support.

All piping having such supports that are not pinned or blocked shall be held securely in place by other temporary means throughout the testing. After successfully passing the hydrostatic test, the pin or blocking device shall be removed.

After the piping has been completely installed, insulated, and filled with its normal operating medium, the springs shall be adjusted to the "C" or cold position.

Welding of pipe supports to structural steel forming a part of the building supporting structure shall be in accordance with the requirements of Supplemental Specification Q280 in Section 01400. Generally, welds shall run parallel with the length of the beam and all welding of lugs or attachments shall be

staggered on the sides, with cooling allowed between subsequent weld bead deposits. Loaded beams shall be unloaded or properly shored prior to field welding if 10 percent or more of the flange width or web depth should be heated to over 500° F at any one time.

15921.3.8 Cutting and Drilling Structures

All necessary drilling, cutting, and patching of structures required for proper installation of piping or bolts shall be done, but only as indicated on the drawings, specified herein, or with the consent of the Engineer. Any penetrations provided by others are shown on the drawings.

Holes shall not be cut in structural steel. Wherever possible, clamps shall be used for attaching erection rigging. Lugs may be welded to structural steel only with the consent of the Engineer. Upon completion of the work, the lugs shall be removed and the surfaces ground smooth.

Holes cut in grating or floor plate shall be banded and reinforced in accordance with the details indicated on the drawings, if details are provided. If no details are indicated on the drawings, holes cut in floor grating shall be banded with 1/4 inch steel bands or standard weight steel pipe welded to the main carrying bars. The bands shall extend the full depth of the grating and shall project 4 inches above the top of the grating.

If normal grating support is removed by the cutting of holes, the Contractor shall add miscellaneous angles or other steel as required to properly support the grating.

All field cut holes and sleeves shall have adequate provisions to allow for insulation and expansion of piping as required.

15921.3.9 Equipment Connections

When attaching piping to equipment connections, special care shall be taken so that excessive stresses are not transmitted to, and imposed upon, such connections. Piping connections to rotating equipment shall not be finalized until the shaft is aligned and the equipment grouted in. As piping is connected, shaft alignment shall be monitored to determine if piping stress causes any change. An indicator tolerance beyond 0.002" shall typically require correction. The Construction Manager shall make the final determination of tolerance depending on the equipment service.

In the case of flanged connections, the piping shall be installed and supported so that accurate matching of bolt holes and uniform contact over the entire flange area are obtained prior to the installation of any flange bolts. Bolts shall be carefully tightened to uniformly compress the gaskets and minimize flange stress.

Special precautions shall be taken in allowing for shrinkage during the welding of nozzle connections so that excessive stresses are not imposed on the equipment.

Fit-up of the flanges to equipment connections may be checked after the bolting has been installed at the request of the Construction Manager. Such bolting shall be removed and replaced and new gaskets installed if requested by the Owner.

Piping erection connections to rotating equipment shall not commence until the rotating equipment has been installed, aligned, and grouted in place. For connections to rotating equipment, piping erection shall start at equipment connections and progressively build away from the equipment connection to the farthest distance practical; this shall mean, as a minimum, that at least the first three dead weight supports going away from the connection shall be installed on the piping being erected. Pipe misalignment adjustments shall not be made within this minimum distance from the rotating equipment. Flange connections should be initially fit and held in relative position using machine pins or other loose-fitting devices. Flange bolts shall not be installed until after final flange alignment and rough equipment

alignment has been completed. Rough alignment is required to ensure that final alignment is achievable. The equipment shall be securely bolted to the structure and grouted before flanges are tightened. Travel stops on spring supports shall remain in place until piping erection is complete, insulation erection is complete, liquid filled piping (if applicable) is filled with the process fluid, and all temporary supports are removed. Travel stops shall be installed and remain in place during hydrostatic testing. If the flanged connections are to be disconnected, the travel stops shall be installed prior to draining the piping system. Pipe support turnbuckles shall be used to adjust the spring supports, as indicated in the pipe support installation instructions, to unload the travel stops prior to removal.

Final alignment checks and manufacturer representative's acceptance of connection alignment shall only be performed with all travel stops in place and all temporary supports removed. Making up of the welded joints on the steam generator, turbine generator, boiler feed pump turbines, boiler feed pumps, and similar equipment shall be done in strict accordance with the equipment manufacturer's requirements and under the supervision of the equipment manufacturer's representative. It shall be the Contractor's responsibility to determine the manufacturer's requirements.

When welding to the exterior of coated tanks, all tank connections and the immediate tank area shall be wrapped. The wrappings shall be kept wetted. Care shall be taken to protect the tank coating during the welding operation.

After startup, if the connecting piping is found to be exerting excessive strains on the equipment, the piping shall be altered by adjusting the piping supports, cutting and rewelding joints, and removing sections of piping, all as necessary to eliminate the excessive strains.

15921.3.10 Valve Installation

Excessive piping strains and bending moments on valves, especially Class 150 large steel gate valves and butterfly valves, shall be avoided. Excessive strains and moments will result in distorted valve seats.

All steel globe valves shall be installed, wherever possible, in such a manner that closing of the valve will relieve the pressure from the packing and permit repacking of the valve with the plant in normal operation. This shall be accomplished by installing the valves on all branch lines from a pressure source, with the pressure under the seat of the valve. In the case of a bypass line, or a line containing two or more globe valves connecting two pressure sources that cannot be taken out of service after the plant is in normal operation, the valve at each end of the line shall be installed in such a manner that the connecting line between the valves may be taken out of service for repacking of both valves when they are closed. Exceptions to the above requirements are those valves for which the manufacturer indicates the required direction of flow through the valve and those valves for which the direction of flow is indicated on the drawings.

Valve disks and plugs shall be off the valve seats when welding valves into the lines.

Check valves shall not be installed in vertical runs of piping unless they are specifically designed for vertical operation.

15921.3.11 Not Used

15921.3.12 Not Used

15921.3.13 Making Flanged Connections

The faces of all flanges and gaskets shall be wiped clean when making up flanged joints. The contact faces of all flanges shall meet squarely, and particular care shall be exercised in pulling up flanged joints to prevent overstressing of flanges or flange bolting.

The threads of all bolting shall be painted with a suitable thread lubricant before the joint is made. The lubricant shall be suitable for the operating temperatures involved.

15921.3.14 Not Used

15921.3.15 Not Used

15921.3.16 Miscellaneous Small Connections

All openings for vents, drains, instruments, and other similar connections made after erection of the piping systems shall be drilled. No burning of such openings will be permitted. Connections shall be made in accordance with the details indicated on the drawings, if details are provided. Any burrs remaining on the inside wall of the pipe after drilling shall be removed.

The low points of all water piping systems and other systems specified to be hydrostatically tested shall be provided with 3/4 inch minimum screwed plugged openings as indicated on the drawings and as required to permit drainage of the systems.

Inspection plugs, drain plugs, and temperature instrument wells having threaded connections to lines operating above 1500 psi or 950 °F shall be seal welded.

15921.3.17 Damage to Machined Surfaces

Special measures shall be taken to avoid damage to machined surfaces such as flange facings or pipe ends that have been prepared for welding. Any damage to welding ends shall be repaired prior to butting up for welding. If a flange facing is marred, scratched, or damaged to such an extent that, in the opinion of the Engineer, the flange will be a cause for leakage, such flange shall be repaired or replaced.

When welding to equipment that is in the assembled condition, separate ground leads shall be attached to the equipment, pipes, or components to prevent stray welding currents from arcing the internals of the equipment. Wherever possible, the ground lead shall be 2/0 cable or larger directly and mechanically connected adjacent to the welding area and returned directly to the welding power source.

15921.3.18 Piping Isolation

All necessary flange isolating materials and insulated bushings, unions, and couplings shall be installed as indicated on the drawings and as required to properly isolate the piping. Bolting at insulated flanges shall consist of studs and nuts with sufficient stud length to allow at least one full stud thread protruding through each nut. Sleeves shall extend into the insulating washers. After installation, insulated flanges, bushings, unions, and couplings shall be tested to determine that the piping is properly electrically isolated to the satisfaction of the Engineer.

The Contractor shall electrically isolate the designated piping from connecting piping and equipment, reinforcing steel, structural steel, the station grounding system, and other buried piping.

15921.3.19 Not Used

15921.3.20 Not Used

15921.3.21 Not Used

15921.3.22 Not Used

15921.3.23 Not Used

15921.3.24 Underground Piping

Underground piping shall be installed as indicated on the drawings and as specified herein.

Excavation, trenching, embedment, and backfilling shall be in accordance with the requirements of Section 02200 - Earthwork.

15921.3.24.1 Not Used.

15921.3.24.2 Not Used.

15921.3.24.3 Grade and Alignment. Piping shall be laid to the lines and grades indicated on the drawings. Laser beam equipment, survey instruments, or other acceptable construction methods shall be used to maintain alignment and grade.

All trenches shall be so graded and pipe so installed that the pipe, when laid on the trench bottom as previously prepared and graded, will be in accurate horizontal and vertical position.

All pipe shall be brought to the terminal points specified. For mislocated terminal points, the Engineer shall determine the means for correction. Bending will only be permitted if approved by the Engineer.

15921.3.24.4 Laying Pipe. Pipe shall be protected from lateral displacement by pipe embedment material installed as specified for trench backfill. Under no circumstances shall pipe be laid in groundwater in excavated trenches, and no pipe shall be laid when trench conditions are unsuitable. Trench bottoms that become unstable shall be stabilized in accordance with the requirements stated in these specifications.

15921.3.24.5 Closures. When pipe laying is stopped at the end of the day, or for any other reason, the end of the pipe shall be closed with a watertight plug or bulkhead. All branch outlets shall be adequately sealed as soon as the special or fitting is laid. It is essential that mud, sand, or debris be excluded from the lines at all times.

15921.3.25 Not Used

15921.3.26 Mechanical Joint Pipe Installation

Mechanical joint pipe shall be assembled in complete accordance with the manufacturer's instructions and recommendations. If effective sealing is not obtained in the assembly of mechanical joints, the joint shall be disassembled, cleaned, and reassembled. Overtightening bolts to compensate for poor installation practice will not be permitted.

Cutting shall be performed in a neat manner, without damage to the pipe. Cuts shall be straight, smooth, and at right angles to the pipe axis. Ends of ductile iron pipe shall be cut with a saw or abrasive wheel.

15921.3.27 Push-on Joint Pipe Installation

All instructions and recommendations of the pipe manufacturer relative to gasket installation and other jointing operations shall be followed by the Contractor. All joint surfaces shall be lubricated with heavy vegetable soap solution immediately before the joint is completed. Lubricant shall be suitable for use in potable water, shall be stored in closed containers, and shall be kept clean. Each spigot end shall be suitably beveled to facilitate assembly.

Cutting shall be performed in a neat manner, without damage to the pipe. Cuts shall be straight, smooth, and at right angles to the pipe axis. Ends of ductile iron pipe shall be cut with a saw or abrasive wheel.

15921.3.28 Installation of Restrained Push-on Joint Pipe

Where restrained push-on joints are provided, the joints shall be assembled in complete accordance with the manufacturer's instructions and recommendations and in accordance with the specified standard. If effective sealing is not obtained in assembly of a joint, the joint shall be disassembled, cleaned, and reassembled with a new gasket. Field grooving of pipe shall be permitted only on closure pieces. Field cut grooves shall be within the dimensional tolerances of the specified standard.

15921.3.29 Nonmetallic Pipe Installation

The installation of nonmetallic piping, including fiberglass reinforced plastic pipe and high density polyethylene pipe or other nonmetallic pipe, shall be as specified herein.

Nonmetallic piping shall be installed in strict accordance with the piping manufacturer's installation recommendations. Special attention shall be given to the manufacturer's recommended ambient installation temperatures, recommended embedment materials, pipe jointing system requirements including preparation and curing times and techniques, support requirements during installation, and recommended backfilling sequence and technique.

The Contractor shall submit evidence to the Owner that the piping manufacturer has reviewed the piping system layout and has provided proper guidance for the installation work to be completed successfully. The Contractor shall advise the Owner of any piping system layout modifications recommended by the manufacturer or otherwise required to properly install the piping. After receipt of concurrence from the Engineer, the Contractor shall proceed with such changes at no cost to the Owner.

Nonmetallic pipe shall be pressure tested after installation as follows. Where the Pipeline List specifies an initial service leak test (ISLT), the pipe "rated pressure" shall be deemed to be the Pipeline List specified design pressure. Otherwise the "rated pressure" shall be the Pipeline List specified test pressure.

Cycle: Pressurize the entire nonmetallic pipe system to the rated pressure five (5) times, holding at rated pressure for five (5) minutes and at zero (0) pressure for five (5) minutes during each cycle. This requirement for cycling is in addition to ASME B31.1 requirements.

Hold: Pressurize the entire nonmetallic pipe system to the specified test pressure and hold at this pressure for two (2) hours.

Test: Reduce pressure to specified design pressure and walk down the entire system to check for leaks.

Repair: If any leaks are found, they shall be repaired per manufacturer's recommendations and the entire process specified above shall be repeated until the entire system is demonstrated to be leak free.

15921.3.30 Not Used

15921.3.31 Testing

Where required by Article 15921.1.1, materials and equipment tests shall be made by the Contractor as specified herein, as specified on the Pipeline List, and as required by code requirements and local and state regulations. Nonmetallic pipe shall be pressure tested per Article 15921.3.29.

Water used to test lines shall be clean, filtered, fresh water (service water or better) and shall be chemically treated to inhibit biological organisms. Treatment levels shall not exceed 2 mg/L of residual chlorine.

Testing water shall not be left to stagnate in the lines.

All materials, equipment, tools, instruments, blocking, bracing, bulkheads, blanking plates, and all labor required to complete the tests shall be furnished by the Contractor. Test water and chemicals shall be furnished by the Contractor as specified in Article 15921.1.1.

If any tests reveal unsatisfactory materials of workmanship, such materials or installation shall be repaired or replaced to the satisfaction of the Engineer.

15921.3.31.1 Pressure Testing of Piping. When a test pressure is specified for a piping system in the Pipeline List, the specified test pressure shall be applied to the system upon completion of erection. Where no test pressure is specified, pressure testing is not required for that system except as specified otherwise herein.

Except as otherwise specified herein or in the Pipeline List for "air test," all pressure testing shall be done hydrostatically in accordance with ASME B31.1. Leaks shall be repaired and the system retested until accepted by the Engineer as satisfactory.

The test pressure shall not be applied until the components being hydrostatically tested and the pressurizing medium are at approximately the same temperature. All expansion joint control rods and attachments shall be properly adjusted before application of test pressure.

Before applying the test pressure, all air shall be expelled from the piping being hydrostatically tested. If required, taps at the high points of the piping systems shall be made and shall be plugged upon completion of the testing. The addition of high point vents on alloy piping shall be approved by the Engineer.

All piping furnished by the Contractor shall be hydrostatically tested under these specifications. If defects are discovered in the piping tested, the Contractor shall repair all defects. All costs incurred as a result of defects in piping, including costs of subsequent retesting, will be borne by the Contractor.

Piping that must be hydrostatically tested, but would be adversely affected by rust as indicated in Article 15921.1.1 or as directed by the Engineer, shall have a rust preventive added to the test water and shall be forced-air dried after testing. The chemicals shall be added while the piping system is being filled. All temporary piping and equipment required for the addition of the chemicals shall be furnished.

All end closures shall be left in place to prevent foreign materials from entering the piping during other work. The low points of the piping shall be provided with drain taps and plugs. All plugs in the piping shall be seal welded.

15921.3.31.2 Not Used.

15921.3.31.3 Leakage Tests. When a leakage test is specified for an AWWA C301 piping system on the Pipeline List, the specified test pressure shall be applied to the system.

The test pressure shall be maintained within a maximum variation of ± 5 percent during the entire time that the line leakage measurements are being taken.

Leakage measurements shall not be started until a constant test pressure has been established. Compression of air trapped in unvented pipes or fittings will give false leakage readings under changing pressure conditions. After the test pressure to be used has been established and stabilized, the line leakage shall be measured by means of a water meter installed on the line side of the force pump.

Line leakage is defined as the total amount of water introduced into the line as measured by the meter during the leakage test. No pipeline, or tested section thereof, will be accepted if and while it has a leakage rate in excess of 50 gallons per inch of pipe diameter per mile of pipe in 24 hours.

All joints in piping shall be watertight and free from visible leaks during the prescribed tests.

If the leakage test is made after the pipeline has been backfilled and the joints have been covered, and such test shows a leakage rate in excess of the permissible maximum, the Contractor shall make all necessary surveys in connection with the location and repair of leaking joints to the extent required to reduce the total leakage to an acceptable amount.

15921.3.31.4 Not Used

15921.3.32 Cleaning of Pipe

The inside and outside surfaces of all pipe, tubing, valves, and fittings shall be cleaned of all dirt, sand, loose mill scale, and other foreign materials immediately after removal from storage and before erection. All lines shall be thoroughly flushed or blown before being placed in service.

Water used to flush other lines shall be clean, filtered, fresh water (service water or better) and shall be chemically treated to inhibit biological organisms. Treatment levels shall not exceed 2 mg/L of residual chlorine.

Flushing water shall not be left to stagnate in the lines.

All fuel oil piping and demineralized water piping shall be flushed using the service fluid per the requirements of the Owner. All fuel oil piping and demineralized water piping shall be flushed in accordance with GE Energy guide document GEK 110483c listed in Section 01100.

15921.3.32.1 Not Used.

15921.3.32.2 Not Used.

15921.3.33 Not Used

15921.3.34 Not Used

15921.3.35 Final Adjustment

After a period of initial operation, all flange bolting shall be checked for tightness, and all hangers readjusted.

15921.3.36 Not Used

15921.3.37 Identification

Where indicated in Article 15921.1.1, pipeline identification markers, indicating the pipeline contents, and direction-of-flow arrows shall be furnished and installed on all piping 2-1/2 inches (63 mm) and larger in diameter.

The markers shall be located at strategic points along the pipe length as directed by the Engineer. At least one marker for each pipeline shall be visible at each branch takeoff, at each valve, and at each termination. Each horizontal run of piping greater than 25 feet long shall have at least one sign and, if necessary, additional signs shall be provided so that the distance between signs does not exceed 50 feet.

A list of legends and samples of the markers shall be submitted to the Engineer for acceptance before the markers are ordered. The composition of the legends shall be as directed by the Engineer.

15921.3.37.1 Not Used

15921.3.37.2 Stenciling. Heat resistant black enamel shall be used for stenciled pipe markers. Stenciling shall be done after the completion of final painting.

16410 - Junction Boxes

16410.1 General

The junction boxes described herein shall be furnished and installed under these specifications.

16410.2 Description

The junction boxes shall be provided as identified on the drawings and as listed in the Contract Documents.

16410.2.1 Nameplates

Each junction box shall be identified with an engraved nameplate at the top of the front cover. Each nameplate shall be engraved with the junction box identification indicated on the drawings. Nameplates shall be in accordance with Section 01400 - Technical Supplemental Specifications.

16410.3 Construction

Junction boxes shall be manufactured in accordance with requirements of Section 01400. NEMA type, size, identification, and additional devices, if required, shall be as indicated on the drawings.

Terminal blocks mounted in junction boxes shall be mounted on a sheet steel mounting backplate. Terminal blocks shall be as identified on the drawings and as specified in Technical Supplemental Specification E520. The mounting plate shall be finished with gloss white enamel or a white epoxy coating. Terminal blocks and other devices, if required, shall be mounted by screws with drilled and tapped mounting holes. Mounting of the backplate within the junction box shall be by nuts on a welded stud. No mounting holes may penetrate the outside surface of the box. Wiring, if required, shall be as specified in Section 16510 - Conductors and Accessories.

16430 - Disconnect Switches

16430.1 General

The disconnect switches described herein shall be furnished and installed under these specifications.

16430.2 Codes and Standards

All equipment provided under these specifications shall conform to the applicable standards of ANSI, NEMA, UL, and IEEE, and shall be in accordance with the applicable requirements of the Federal "Occupational Safety and Health Standards."

The switches shall be designed and fabricated in accordance with the requirements of NEMA KS 1 for heavy-duty (Type HD) enclosed switches.

16430.3 Description

Unless otherwise noted in the drawings, the following shall apply. The disconnect switches shall be nonfused or of the fused heavy-duty type, single-throw, rated 600 volts ac. The switches shall be safety type with quick-make, quick-break mechanisms. Provisions shall be provided for padlocking the switches in either the open or closed position. Watertight hubs shall be provided for all NEMA 4 and 4X enclosures.

Disconnect switches shall be furnished in the quantities, enclosure type, with voltage ratings, ampere ratings, short-circuit interrupting rating, number of poles, and fusible or nonfusible, as indicated on the drawings. The fusible disconnect switches shall be furnished with one set of fuses installed in each switch and 100 percent spare fuses. Fuses shall be Bussmann Type FRS-R or acceptable equal, unless otherwise noted on the drawings.

Unless specified otherwise, each switch shall be mounted in a sheet steel enclosure. Each switch enclosure shall be finish painted.

An engraved nameplate shall be furnished mounted on the front of each switch enclosure in accordance with Section 01400 - Technical Supplemental Specifications. The disconnect switch nameplates shall be as listed in the drawings.

16430.4 Installation

The Contractor shall install the switches complete as indicated on the drawings.

16430.5 Manufacturers

Disconnect switches shall be as manufactured by Square D or Engineer approved equal.

16501 - Lighting

16501.1 General

16501.1.1 Scope of Supply

Scope of supply shall include furnishing and installation of the lighting system as specified herein.

16501.1.1.1 Not Used

16501.1.2 Not Used

16501.1.3 Performance and Design Requirements

Performance and design requirements for the equipment and materials to be furnished under this section of these specifications are indicated herein.

For lighting system materials, the following requirements shall also apply in addition to the requirements of this section:

Section 16510, Conductors and Accessories.

Section 16920, Raceway Components and Installation.

16501.1.4 Codes and Standards

Work performed under these specifications shall be done in accordance with the following codes and standards. Unless otherwise specified, the applicable governing edition and addenda to be used for all references to codes or standards specified herein shall be interpreted to be the jurisdictionally approved edition and addenda. If a code or standard is not jurisdictionally mandated, then the current edition and addenda in effect at the date of this document shall apply. These references shall govern the work except where they conflict with the Owner's specifications. In case of conflict, the latter shall govern to the extent of such difference:

Work	In Accordance With
Luminaires	
Fluorescent	UL 542, 935, 1598
High intensity discharge (HID)	UL 496, 1029, 1598
Incandescent	UL 496, 1088, 1574, 1598
Light emitting diode (LED)	UL 8750
Exit, emergency, and emergency power equipment	UL 924
Hazardous area	UL 844
Duplex and single receptacles	UL 498, 943, 1010, 1449, 1682, 1686
Switches, dimmers, contactors, and photocells	UL 20, 508, 773, 894, 1472
Device plates and outlet boxes (unfinished areas)	UL 514

16501.1.5 Materials

The following materials shall be used:

Component	Material
Switches	
Housing and operating levers	Phenolic compound
Device plates	
Finished areas (metal)	Type 430 satin stainless steel
Unfinished areas	Formed sheet steel coated with zinc of cadmium
Weatherproof receptacle and switches	
Plates and lift cover	Cast aluminum
All other metal parts	Stainless steel or Monel metal

16501.1.6 Approved Manufacturers of Components

For the following components, only the listed manufacturers are recognized as maintaining the level of quality of workmanship required by these specifications. If the Contractor wants to propose a non-listed manufacturer that is considered to provide an equivalent level of quality, this manufacturer must be identified and supporting testimony provided. Acceptance of the manufacturer as a substitute is at the discretion of the Owner:

Component	Manufacturer
Convenience Receptacles	
Duplex (gray for finished areas and brown for unfinished areas)	Hubbell (Generic Cat. No. 5362), Pass & Seymour, Cooper Wiring, or Leviton
Single (gray for finished areas and brown for unfinished areas)	Hubbell (Generic Cat. No. 5361), Pass & Seymour, Cooper Wiring, or Leviton
Kitchen range and clock outlet	Hubbell, Pass & Seymour, Cooper Wiring, or Leviton
Isolated ground	Hubbell (Generic Cat. No. IG5362), Pass & Seymour, Cooper Wiring, or Leviton
Ground fault interrupting	Hubbell (Cat. No. GF20L), Pass & Seymour, Cooper Wiring, or Leviton
Hazardous rated (Class I, Group D and Class II, Group F areas)	Appleton EFS "U-Line" or Crouse-Hinds ENR Series
Switches	
Single-pole (gray for finished areas and brown for unfinished areas)	Hubbell (Generic Cat. No. 1221), Pass & Seymour, Cooper Wiring, or Leviton
Three-way (gray for finished areas and brown for unfinished areas)	Hubbell (Generic Cat. No. 1223), Pass & Seymour, Cooper Wiring, or Leviton

Component	Manufacturer
Four-way (gray for finished areas and brown for unfinished areas)	Hubbell (Generic Cat. No. 1224), Pass & Seymour, Cooper Wiring, or Leviton
Momentary contact	Pass & Seymour, Cooper Wiring, or Leviton
Two-pole	Hubbell (Generic Cat. No. 1222), Pass & Seymour, Cooper Wiring, or Leviton
Three-way, four-way (Class I, Group D and Class II, Group F areas)	Appleton or Crouse-Hinds "EDS" tumbler series
Dimmers	Lutron "NOVA" series
Device plates	
Device plates (unfinished areas)	Crouse-Hinds or Appleton
Device plates (finished areas)	Hubbell, Pass & Seymour, Cooper Wiring, or Leviton
Weatherproof single receptacle device plates	Crouse-Hinds WLRS-1 or Appleton
Weatherproof duplex receptacle device plates	Crouse-Hinds WLRD-1 or Appleton
Weatherproof switch device plates	Crouse-Hinds DS185 or Appleton
Miscellaneous	
Lamps	General Electric, Osram Sylvania, or Phillips Lighting
Fluorescent dimming system	Lutron Grafik Eye series
Photoelectric controllers	Fisher Pierce N7790B
Lighting contactors	ASCO, Cutler-Hammer, General Electric, Siemens, or Square D
Area lighting in-line fused connectors	Bussmann

16501.1.7 Test Requirements

The following testing shall be conducted in accordance with the specified source. This testing is to be considered part of the defined Scope of Work, and all associated costs are the responsibility of the Contractor:

Tests	In Accordance With	Conducted By
Operational test	Article 16501.1.4	Manufacturer

16501.1.8 Not Used

16501.1.9 Supplemental Specifications

Technical supplemental specifications that are applicable to the work covered under this technical specification section are identified and included in Section 01400.

16501.2 Products

16501.2.1 Luminaires

Luminaires shall be as specified on the drawings.

16501.2.2 Luminaire Supports

All required luminaire supports, hangers, clamps, and fasteners shall be as specified on the drawings.

16501.2.3 Not Used

16501.2.4 Switches

Switches shall be totally enclosed tumbler type with single mounting yoke design. Single and double pole switches shall be position indicating.

16501.2.5 Device Plates

Device plates shall be furnished for all device boxes.

16501.2.6 Not Used

16501.2.7 Lighting Contactors

Lighting contactors shall be as specified on the drawings. Contactors shall include an enclosure rated as indicated on the drawings (NEMA 12 minimum), hand-off-auto control switch, control fuse, and contacts rated for the application.

16501.2.8 Not Used

16501.2.9 Lighting and Convenience Receptacle Conductors

The conductor types for use in the lighting and convenience receptacle circuits shall be provided in accordance with Cable Specification Sheets included in Section 16510 of these specifications or as indicated on the drawings.

16501.2.10 Lighting and Convenience Receptacle Raceway

The following raceway and raceway fittings for use in lighting and convenience receptacle circuits shall be provided:

Raceway Type	Use
Rigid galvanized steel	Installed in indoor non-hazardous areas
Rigid galvanized steel	Outdoors above grade and indoor hazardous areas
Flexible metallic tubing	Luminaire taps in finished areas
Schedule 40 PVC	Area lighting routed underground

16501.3 Execution

If lighting installation is included in the Scope of Supply (16501.1.1), the installation shall be in accordance with Section 16940, Lighting Installation.

16510 - Conductors and Accessories

16510.1 General

16510.1.1 Scope of Supply

Scope of supply shall include conductors and accessories as indicated in the attachments listed in Article 16510.1.8 and as specified herein.

The scope of supply includes the following:

Procurement of materials and installation as part of a construction contract.

16510.1.1.1 Not Used.

16510.1.1.2 Drawings. Drawings, if included, indicate the circuits, locations, and routing for those components that are to be furnished under this Contract. The Contractor shall use the drawings to determine the quantities and types of materials and components to be furnished.

16510.1.1.3 Circuit Lists. Circuit lists, if included, indicate the circuits and approximate circuit lengths for those materials and components that are to be furnished under this Contract. The Contractor shall field verify all circuit lengths referenced in the circuit list and determine the quantities and types of materials and components to be furnished.

16510.1.2 Not Used

16510.1.3 Performance and Design Requirements

Performance and design requirements for the material and components to be furnished under these specifications are indicated herein and on the Conductors and Accessories Specification Sheets included at the end of this section

16510.1.4 Codes and Standards

Work performed under these specifications shall be done in accordance with the following codes and standards. Unless otherwise specified, the applicable governing edition and addenda to be used for all references to codes or standards specified herein shall be interpreted to be the jurisdictionally approved edition and addenda. If a code or standard is not jurisdictionally mandated, then the current edition and addenda in effect at the date of this document shall apply. These references shall govern the work except where they conflict with the Owner's specifications. In case of conflict, the latter shall govern to the extent of such difference:

Work	In Accordance With
ANSI/IEEE/ICEA/UL/NEC	
Power, control, instrumentation, thermocouple, and specialty cables	The codes and standards indicated in the technical attachments, Article 16510.1.8
Flame Testing of Cables for Use in Cable Tray in Industrial and Commercial Occupancies	IEEE 1202
Short-Circuit Performance of Metallic Shields and Sheaths on Insulated Cable	ICEA P-45-482

Work	In Accordance With
Electrical Power and Control Tray Cables with Optional Optical-Fiber Members	UL 1277
UL Standard for Safety – Power Limited Circuit Cables	UL 13
UL Standard for Safety – Flexible Cord and Fixture Wire	UL 62
UL Standard for Safety – Electrical Wires, Cables and Flexible Cords	UL 1581
Cable accessories	AEIC CS8, IEEE 404, IEEE 48

16510.1.5 Materials

The following materials shall be used:

Component	Material
Power, control, instrumentation, thermocouple, and specialty cables	Materials as indicated in the technical attachments, Article 16510.1.8
Cable Accessories	As indicated in Article 16510.2.3

16510.1.6 Approved Manufacturers of Components

For the following components, only the listed manufacturers are recognized as maintaining the level of quality of workmanship required by these specifications. If the Contractor wants to propose a nonlisted manufacturer that is considered to provide an equivalent level of quality, this manufacturer must be identified and supporting testimony provided. Acceptance of the manufacturer as a substitute is at the discretion of the Engineer.

Component	Manufacturer
ICEA/UL low voltage power cable	General Cable, Prysmian (Pirelli), Rockbestos Suprenant, Rome, Southwire, Service Wire, Tamaqua (Draka USA), Kerite, Okonite
ICEA/UL control cable	Belden, Dekoron, General Cable, Prysmian (Pirelli), Rockbestos Suprenant, Southwire, Shawflex, Service Wire, Tamaqua (Draka USA), Okonite
ICEA/UL instrumentation and thermocouple cable	Belden, Dekoron, General Cable, Shawflex, Rockbestos Surprenant
ICEA/UL insulated ground cable	General Cable, Essex/Royal, Okonite, Rockbestos Suprenant, Southwire, BIW Tamaqua
Fiber-optic	Corning, Belden, General Cable, or approved equal
Specialty cable	As indicated in the technical attachments, Article 16510.1.8

Component	Manufacturer
Accessories	As indicated in Article 16510.2.3

16510.1.7 Test Requirements

The following testing shall be conducted in accordance with the specified source. This testing is to be considered part of the defined Scope of Work, and all associated costs are the responsibility of the Contractor:

Tests	In Accordance With	Conducted By
Standard	Applicable ANSI, IEEE, ICEA, AEIC and UL Standards or Applicable IEC Standards	Manufacturer
Cable type tests, production tests, routine tests and flame tests	The codes and standards indicated in the technical attachments, Article 16510.1.8	Manufacturer
Cable Flame Tests	The codes and standards indicated in the technical attachments, Article 16510.1.8	Manufacturer
Post-installation testing		Contractor

16510.1.8 Technical Attachments

The attachments accompany these specifications and are located in Appendix A.

16510.1.9 Supplemental Specifications

Technical supplemental specifications that are applicable to the work covered under this technical specification section are identified and included in Section 01400.

16510.1.10 Certification Requirements

Certified test reports for each type of power cable furnished under this Contract shall be provided in accordance with the requirements of ICEA S-95-658 (ICEA/UL LV power cable) and other applicable standards as indicated in the technical attachments, Article 16510.108.

16510.2 Products

16510.2.1 Conductors and Accessories - General Requirements

The design and construction of insulated conductors shall be in accordance with manufacturer and utility industry standard practices, except as modified in accordance with these specifications. All insulated cable, conductors, and accessories shall meet the operating conditions and requirements as specified herein and on the Conductors and Accessories Specification Sheet.

The term "Type" used in the Circuit List, on the drawings, and in these specifications refers to the letter identification indicated in the upper right corner of each Cable Specification Sheet.

16510.2.1.1 Design Life. All equipment, components, and materials shall have a useful design life of 40 years, accounting for corrosion, erosion, and material degradation.

16510.2.1.2 Engineering Data. The Contractor shall submit his product specification drawings for all specified cable and accessories to the Engineer in accordance with the Schedule of Contract Submittals. The drawings shall include dimensions and materials of construction for all materials. Material furnished shall be in accordance with the product specification drawings that receive approval by the Engineer.

16510.2.1.3 Splicing. Splicing is prohibited, except by the installation contractor with approval by the Engineer, for use with lighting conductors and instances where the installed conductors must be connected to factory installed pigtails (motors, solenoids, switches, (etc.).

16510.2.1.4 Stripping Requirements. Any material in contact with the conductor shall be free-stripping. Cables which require wire brushing of the conductor or dipping of the conductor into molten solder to facilitate termination are not acceptable. If the material in contact with the conductor is not free-stripping, the entire cable reel may be rejected at the option of the Owner, or the Owner may back charge the Contractor for additional labor required to strip the material.

16510.2.1.5 Maximum Cable Diameter. The Contractor shall state in his proposal the guaranteed maximum outside diameter for each cable supplied. The actual outside cable diameters shall not exceed the guaranteed maximum outside diameter stated in the Contractor's proposal.

Cable diameters may be measured in the field to determine compliance with the maximum outside diameter stated in the Contractor's proposal. If any of the measured diameters of the cable on any reel are in excess of the maximum value stated in the Contractor's proposal, the cable reel may be rejected by the Owner.

16510.2.1.6 Not Used

16510.2.1.7 Conductor Identification.

Conductor identification of cables rated 2000 volts (ICEA/UL) or 1 kV (IEC) and less shall be as specified on the Cable Specification Sheets.

16510.2.1.8 Length. If cable lengths are indicated in the attachments to this specification, the cable lengths represent estimated total lengths of each cable type and size which will be required.

16510.2.1.9 Field and Post Installation Tests. Shall be per Articles 16925.3.5 and 16925.3.

16510.2.2 AEIC/ICEA/UL Cable - Technical Requirements

16510.2.2.1 Conductors. Conductor material, construction and stranding shall be as specified on the Cable Specification Sheets. Copper conductors can be either coated or uncoated copper conductors. Uncoated copper conductors may be supplied if the manufacturer guarantees that the material in contact with the conductor will not corrode the copper. The Contractor may supply either round or compressed conductors.

16510.2.2.2 Not Used

16510.2.2.3 Insulation. The insulation material shall meet the requirements as specified herein and as indicated on the Cable Specification Sheets. Core identification shall be by numbers printed on the insulation or by coloring of insulation as specified on the Cable Specification Sheets. The conductor insulation shall be a high quality, heat and moisture-resisting compound. The insulation shall fit tightly to the conductor or conductor shield (screen). The insulation shall be applied so that it can be cleanly stripped in the field with conventional stripping tools. Cable strand and insulation shall be free of water and water vapor. The Manufacturer shall fully describe his methods and procedures for drying and testing cables.

16510.2.2.4 Not Used

16510.2.2.5 Not Used

16510.2.2.6 Not Used

16510.2.2.7 Not Used

16510.2.2.8 Not Used

16510.2.2.9 Inspection and Testing. Cables shall be inspected and tested in accordance with the appropriate codes and standards as indicated in Article 16510.1.4 and on the Cable Specification Sheets.

16510.2.2.9.1 Not Used

16510.2.2.9.2 Not Used

16510.2.2.9.3 Production tests (ICEA/AEIC Cables). Where applicable, the following tests shall be provided for each cable manufactured. Tests shall be made on all cable in accordance with the applicable standards as indicated on the Cable Specification Sheets.

Production Test Requirements	
Conductor Tests	
All cables	Conductor wire prior to stranding, elongation, finish, continuity, stranded conductor elongation tests, dc resistance determination, cross-sectional area determination, and diameter determination
Insulation Tests (all cables)	
Physical requirements	Tensile strength, elongation, and elongation at rupture
Aging requirements	Tensile strength and elongation at rupture after aging
Other tests (all cables)	Hot creep tests, insulation resistance constant, ozone resistance, and accelerated water absorption
Electrical Tests	
All cables	Ac voltage withstand, insulation resistance, conductor continuity, and spark tests for non-shielded single-conductor cables
Other tests as required by the applicable codes and standards	

16510.2.3 Accessories

16510.2.3.1 General. This article covers conductor accessories. All conductor accessories shall be provided as indicated in Article 16510.1 and as specified herein.

16510.2.3.2 Terminal Connectors.

16510.2.3.2.1 Terminal connectors for conductors 8 AWG and larger. Terminal connectors for conductors 8 AWG (10 mm²) and larger shall be pressure or bolted clamp type, Burndy Qiklug, Varilug, or acceptable equal; or compression type, Burndy Type YAV or YA (long barrel), Panduit Type LCA or LCC, or acceptable equal.

Reducing pin compression connectors (if required and approved for use by Engineer) shall be Burndy Type YE-P, or acceptable equal for cables that are oversized due to voltage drop or derating that will not fit into equipment lugs.

16510.2.3.2.2 Terminal connectors for conductors smaller than 8 AWG. Terminal connectors for conductors smaller than 8 AWG (10 mm²) shall be compression type connectors properly sized for the conductor and the terminal. The connectors shall be constructed of fine grade high conductivity copper and shall be tin-plated. The interior surface of the connector wire barrel shall be serrated, and the exterior surface of the connector wire barrel shall be provided with crimp guides.

Noninsulated terminal connectors shall be provided on conductors terminated on devices equipped with individual fitted covers, such as General Electric Type SB-1 control switches and General Electric Type HEA lockout relays. Preinsulated ring type terminal connectors shall be used on all current and potential transformer circuits. All other terminal connectors for conductors smaller than 8 AWG (10 mm²) shall be preinsulated ring type or preinsulated spade type.

Preinsulated terminal connectors shall include a vinyl insulating sleeve, color coded to indicate conductor size. Preinsulated terminal connectors shall include a metallic support sleeve bonded to the vinyl insulating sleeve and designed to grip the conductor insulation.

Ring type connectors shall be manufactured by AMP, 3M, Panduit, or acceptable equal. Spade type connectors shall be AMP slotted spring spade, 3M Scotchlok Series 6I snap spade, Panduit locking fork terminal connectors, or acceptable equal.

Ferrules shall be provided on all stranded conductors that are to be terminated to compression type IEC terminal blocks.

16510.2.3.3 Terminal Blocks. Terminal blocks shall meet the requirements of the Technical Supplemental E520, Terminal Blocks and Fuse Holders.

16510.2.3.4 Splicing Connectors. Splices to factory installed pigtails shall be with compression type connectors. Splices in lighting conductors smaller than 8 AWG (10 mm²) shall be with 3M Company "Scotchlok" twist type insulated spring connectors, Panduit JN wire joints, or acceptable equal. Splices in lighting conductors 8 AWG (10 mm²) and larger shall be with compression type connectors, 3M Company 5300 Series (600V), 3M Company 5500 Series (5 and 15 kV), Raychem Type HVS (5 and 15 kV), (or equal).

16510.2.3.5 Crimping Tools. Crimping tools used to secure conductors in compression type connectors or terminal lugs shall be those made for that purpose and for the conductor sizes involved. The crimping tools shall accurately crimp the connector barrel and shall accurately crimp the conductor insulation support sleeve where provided. Crimping tools shall be provided with guides to position connectors in the tool, shall be provided with stops to prevent overcrimping, and shall be of a type which prevents the tools from opening until the crimp action is completed. Crimping tools shall be a product of the connector manufacturer or shall be as recommended by the connector manufacturer and acceptable to the Owner for use with the connectors.

16510.2.3.6 Insulating Materials. Insulating materials for splice and termination insulation shall be in accordance with the following.

16510.2.3.6.1 1000 volt (or less) cable. Insulating materials for terminal connections in motor terminal housings shall be Raychem Type MCK, 1000 volt motor connection kits, 3M Company 5300 Series or acceptable equal.

Insulating materials for terminal connections to busbar shall be Raychem Type FCSM heavy wall flame retardant sleeves with Raychem S1052 electrical putty, or equal, applied to obtain an environmental seal where multiple cables enter a single sleeve.

Where heat shrink insulating sleeves and boots cannot be used, insulating materials for terminal connectors or compression type splicing connectors shall consist of varnished cambric tape, rubber tape, and vinyl tape. Taping materials shall be as listed below or acceptable equal:

Varnished Cambric Tape - 3M Company Irvington 2520.

Rubber Tape - 3M Company Scotch 130C.

Vinyl Tape - 3M Company Scotch 33+.

Copper Braid Tape – 3M Company Scotch 24

16510.2.3.6.2 Not Used

16510.2.3.7 Support Grips. Cable support grips shall be either split or closed woven wire type as manufactured by The Kellems Division, Harvey Hubbell Incorporated, Stonington, Connecticut, Daniel Woodhead Co., or equal.

16510.2.3.8 Wire and Cable Markers. Markers for wire and cable circuits shall be of an opaque nylon material arranged to include a marker board, nonreleasing holding device, and cable fastening tail. The marker board shall not be less than 0.75 inch by 2.5 inch (19 mm by 63.5 mm) and shall be Panduit Corp., Part No. MP250 marker plates or acceptable equal. One side shall be roughened to hold black nylon marking ink from a fine tip pen similar to Thomas & Betts Company "TY-RAP" marking pen, Catalog No. WT163M-1, or Panduit Corp., Part No. PFX-O marking pen or equal. Identification shall be permanent and waterproof. The holding device shall be designed to allow the fastening tail to pass around the cable through the holding device and prevent the removal of the tail without cutting it loose from the marker.

16510.2.3.9 Cable Ties. Lacing materials for field installed cable shall be nonreleasing weather-resistant black nylon ties manufactured by Thomas & Betts Company, Elizabeth, New Jersey; Panduit Corp., Tinley Park, Illinois; 3M Company; or acceptable equal.

16510.2.3.10 Arcproofing Material. Material for the arcproofing of nonflame retardant cable shall be an unsupported intumescent self-extinguishing elastomer tape, 3M Company Scotch Brand No. 77 or acceptable equal, and a pressure sensitive silicone adhesive backed glass cloth holding tape, 3M Company Scotch Brand No. 69 or acceptable equal.

16510.2.3.11 Not Used

16510.2.3.12 Cable Glands. Cable glands shall meet the requirements of the Technical Supplemental E100 - Wiring Methods, Cable, and Raceway. Cable glands shall be supplied kit form complete with earthtags, locknuts, and shrouds. The Contractor shall coordinate the cable gland with the outside

diameter of the proposed cable. One insulated adapter shall be supplied for each circuit designated as single point bonded. The combination of earthtag and cable glands shall be capable of withstanding the available earth fault current for the designated time.

16510.2.3.13 Pulling Lubricant. Pulling lubricant shall be provided as recommended by the cable manufacturer.

16510.3 Execution

If installation is included in the scope of work, installation shall be in accordance with the requirements of Section 16925 - Conductors Installation.

16847 - Project Completion and Finishing

16847.1 General

This specification covers the cleanup and final restoration of the work areas and project area.

16847.1.1 Scope of Work

Scope of work shall include all work associated with final cleanup and restoration of all areas disturbed by the project. All areas shall be restored to the condition existing before the project or better in the opinion of the Owner.

16847.1.2 Not Used

16847.1.3 Performance and Design Requirements

For more performance and design requirements refer to Article 16847.3.

16847.1.4 Not Used

16847.1.5 Not Used

16847.1.6 Not Used

16847.1.7 Not Used

16847.1.8 Technical Attachments

Technical attachments relevant to the work under this section are listed in Section 01100.

16847.1.9 Supplemental Specifications

Technical supplemental specifications that are applicable to the work covered under this technical specification section are identified and included in Section 01400.

16847.2 Not Used

16847.3 Execution

16847.3.1 General

After all other construction described in the contract is completed and before Acceptance of the contract, the entire project area including, but not limited to, roadways, planting areas, sidewalk areas, shoulders, driveways, alley and side street approaches, slopes, ditches, utility trenches, and construction areas shall be neatly finished to the lines, grades, and cross sections as shown on the contract drawings.

Slopes, sidewalk areas, planting areas, and roadway shall be smoothed and finished to the required cross section and grade by means of a grading machine insofar as it is possible to do so without damaging existing improvements, trees, and shrubs. Machine dressing shall be supplemented by hand work to meet requirements outlined herein, as approved by the Owner.

Upon completion of the cleaning and dressing, the project area shall appear uniform. Graded areas shall be true to line and grade as shown on the typical sections and as directed by the Owner. Where the re-landscaped planting is below sidewalk and curb, the area shall be filled and dressed out to the walk regardless of limits as directed by the Owner. Wherever fill material is required in the planting area, it shall be left high enough to allow for final settlement but, nevertheless, the raised surface shall present a uniform appearance.

Rocks of 1 inch diameter and larger shall be removed from developed areas disturbed by the construction operations and shall be disposed of as required for other waste material. In no instance shall the rock be thrown onto private property. Overhang on slopes shall be removed and slopes dressed neatly so as to present a uniform well sloped surface.

Windrows of earth at the outer lateral limits of the project shall be removed entirely. Trash resulting from clearing and grubbing or grading operation shall be removed and disposed of at a site obtained by the Contractor. Where machine operations have broken down brush and trees beyond the lateral limits of the project, the Contractor shall remove, dispose, and replace in kind of same at no additional cost to the Owner. Drainage facilities such as inlets, catch basins, culverts, and open ditches shall be cleaned of debris.

Construction stakes shall be removed and disposed of.

Where portions of the construction are in undeveloped areas, the entire area that has been disturbed by the construction shall be shaped so that upon completion the area will present a uniform appearance, blending into the contour of the adjacent properties.

16847.3.2 Seeding and Sodding

All areas that are included within the project work area and that are not covered by crushed rock surfacing or paved surfacing shall be re-vegetated by application of seed, sod, fertilizer, and mulch in accordance with Section 02371. The Contractor shall sod or seed at the direction of the property owner.

16920 - Raceway Components and Installation

16920.1 General

This section covers the furnishing and field installation of all electrical raceway systems and components. The raceway system and installation shall be in accordance with the drawings, the Raceway List if provided, and these specifications.

The raceway system is defined to include conduit, flexible conduit, below grade conduit, direct bury conduit, duct bank, wireway, junction boxes and pull boxes, and all materials and devices required to install, support, secure, and provide a complete system for support and protection of electrical conductors.

16920.1.1 Scope of Supply

Any materials not specified as being furnished by others, but which are required for a complete raceway installation, shall be furnished.

16920.1.2 Not Used

16920.1.3 Performance and Design Requirements

Performance and design requirements for the equipment to be furnished under this section of these specifications are indicated herein.

16920.1.4 Codes and Standards

Work performed under these specifications shall be done in accordance with the following codes and standards. Unless otherwise specified, the applicable governing edition and addenda to be used for all references to codes or standards specified herein shall be interpreted to be the jurisdictionally approved edition and addenda. If a code or standard is not jurisdictionally mandated, then the current edition and addenda in effect at the date of this document shall apply. These references shall govern the work except where they conflict with the Engineer's specifications. In case of conflict, the latter shall govern to the extent of such difference.

Raceway systems and components furnished with these specifications shall be manufactured in accordance with applicable standards of the American National Standards Institute (ANSI), the National Electrical Manufacturers Association (NEMA), and Underwriters' Laboratories, Inc. (UL). Raceway systems and components shall be installed in accordance with the applicable requirements of the National Electrical Code (NEC) and the Occupational Safety and Health Administration (OSHA) standards.

Areas subject to conditions classified in the NEC as hazardous areas are indicated on the drawings. Raceway systems and components furnished and installed in these areas shall meet the requirements of the NEC for the hazardous condition indicated.

16920.1.5 Not Used

16920.1.6 Approved Manufacturers of Components

For the following components, only the listed manufacturers are recognized as maintaining the level of quality of workmanship required by these specifications. If the Contractor wants to propose a nonlisted manufacturer that is considered to provide an equivalent level of quality, this manufacturer must be identified and supporting testimony provided. Acceptance of the manufacturer as a substitute is at the discretion of the Engineer:

Component	Manufacturer
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Component	Manufacturer
Post-installed mechanical anchor bolts	Hilti Kwik-Bolt TZ
Fire stops	Nelson Fire Stops Flame-Safe Fire Stop Systems Fire Stop Systems
Conduit - Steel	Allied Tube and Conduit Triangle PWC, Inc. Wheatland Company
Conduit - Plastic	Cantex PVC Products Carlson Plastic Conduit
Conduit - Flexible	Anamet Canada, Inc. Liquatite International Hose Company
Conduit bodies and fittings - Metal	O-Z/Gedney Crouse-Hinds Appleton
Conduit bodies and fittings - Plastic	Cantex PVC Products Carlson Plastic Conduit
Support channels and fittings	Unistrut Metal Framing B-Line Strut Systems
Conduit supports	O/Z/Gedney Crouse-Hinds Appleton
Wireway	B-Line Raceway Systems Hoffman Engineering Company Lee Products Company
Boxes and enclosures - Metal	Hoffman Engineering Company Wiegmann Appleton Hammond Manufacturing Co.
Boxes and enclosures - Plastic	Hammond Manufacturing Co. Carlson Plastic Products Crouse-Hinds

16920.1.7 Not Used

16920.1.8 Not Used

16920.1.9 Supplemental Specifications

Technical supplemental specifications that are applicable to the work covered under this technical specification section are identified and included in Section 01400.

16920.2 Not Used

16920.3 Execution

16920.3.1 General Installation Requirements

The installation specifications included in this article apply to all raceway system components.

16920.3.1.1 Routing of Above Grade Raceway. Conduit shall be field routed according to the general routing indicated on the drawings. The location of field routed raceway and all raceway supports shall be coordinated with other equipment and structures.

Wherever practical, field routed raceway shall be routed so that, except where it is changing floor elevations or being lowered to enter equipment, the lowest part of the raceway, including its associated supports and appurtenances, is at least 7'-6" (2.3 m) above the closest floor or walking surface beneath it. Field routed raceway and its associated supports and appurtenances, located at least 7'-6" (2.3 m) above the closest walking surface, may be routed a reasonable distance away from the supporting wall, ceiling, or structural member so long as the specified support is provided and interference with other equipment and structures is avoided. Field routed raceway and its associated supports and appurtenances, which must be routed closer than 7'-6" (2.3 m) above the closest walking surface, shall be routed as close as possible to surfaces of walls, columns, and the equipment served.

Field routed raceway and all raceway supports shall be located at least 6 inches (150 mm) from the final outside surface of all steam piping, including insulation, and 2 inches (50 mm) from the final outside surface of all other piping, including insulation if provided. Consideration shall be given to the thermally expanded position of piping when field routing raceway.

Field routed raceway and all raceway supports shall be located so that they do not interfere with equipment which expands, vibrates, or moves under normal operation such as a steam generator, flue gas ductwork, or overhead crane.

16920.3.1.2 Brackets. Bracket supports as detailed on the drawings shall be used where specifically indicated and may be substituted for other types of hangers where acceptable to the Engineer.

16920.3.1.3 Raceway Attached to Concrete. Where raceways are supported from concrete surfaces or floors, the anchorage shall be Hilti Kwik-Bolt TZs, or Engineer accepted equal meeting Federal Specification A-A-1923A, IBC, and ACI 318, Appendix D. Raceways mounted on concrete or masonry walls shall be mounted so that there is a minimum of 1/4 inch (6 mm) of air space between the raceway and the concrete or masonry wall.

Raceway supports attached to concrete floors shall be installed such that they are elevated and grouted above the finished floor a minimum of 1 inch (25 mm) to prevent corrosion caused by exposure to standing water.

16920.3.1.4 Raceway Attached to Building Steel. Except as otherwise specified, indicated on the drawings, or acceptable to the Engineer, raceway or all raceway supports attached to building steel shall be secured by welding, by drilling and tapping, by powder activated devices and fasteners, or by beam clamps.

Raceway and raceway supports shall not be attached to grating.

Raceway and raceway supports shall not be attached to the flanges of the cold-formed support steel in pre-engineered buildings. Instead, raceway and raceway supports shall be attached to the web of the cold-formed support steel by using bolts installed through holes field drilled in the web.

16920.3.1.5 Insulation. Raceway and all supports for raceway connected to equipment, piping, raceways, etc., that have been electrically insulated from contact with other structures shall be properly installed to prevent shunting of the insulation. Particular attention shall be given to bearings on large motors and insulated piping flanges.

16920.3.1.6 Sleeves and Openings. Sleeves and openings for the passage of electrical raceways or conductors will be located beneath major pieces of electrical equipment and in certain locations where raceway or conductors will pass through floors or walls.

The Contractor shall be responsible for all required openings. Required openings not provided during structure fabrication shall be provided by the Contractor. Openings shall be finished and sealed as indicated on the drawings.

16920.3.1.6.1 Openings through steel beams. Conduit may be routed through building steel only when the routing is reviewed for structural integrity by the Engineer and approved. Holes required for conduit passages shall be drilled or sawed, or flame cut with subsequent reaming and/or grinding to prevent ragged edges, notches, cuts, or cracks.

16920.3.1.6.2 Openings through grating. Where openings through grating are required, the openings shall be made at divisions or ends of grating sections, if possible. These openings shall be square and shall be neatly finished by installing a kickplate around the entire opening and welding it to the cut grating bars. All rough spots shall be ground smooth, and welds and cuts shall be regalvanized. Penetrations in grating shall be sawed or flame cut with subsequent grinding to ensure smooth and straight cut appearance.

Openings through grating shall be finished as indicated on the drawings.

16920.3.1.6.3 Openings through concrete and masonry. Openings in concrete floors and concrete or masonry walls for single conduits or minimum quantities of conductor shall be cut using a core drill. Larger openings required for multiple conduits, conductors or cable tray shall be cut using multiple core drills chiseled out to the appropriate size, or by saw cutting. The Contractor shall be responsible for providing all necessary materials to protect equipment and personnel from falling debris and water while making the opening.

Required field cut openings larger than 12 inches (305 mm) in any direction shall be approved by the Engineer prior to cutting.

Openings cut through concrete floors and concrete or masonry walls for the passage of conduit shall be finished by either grouting or by sealing around the conduit. Openings in concrete floors for the passage of electrical conductors shall be sealed. Openings in concrete floors and concrete or masonry walls for the passage of cable tray shall be sealed.

Exposed openings between the edge of raceway components and the edge of field cut concrete floor openings exceeding 1-1/2 inches (38 mm) in width shall have kickplate installed around the entire opening.

Openings through concrete and masonry shall be finished and sealed as indicated on the drawings.

16920.3.1.6.4 Openings through metal wall panel. Single conduit openings in metal wall panel shall be hole punched or drilled the minimum size to allow passage of the conduit through the wall panel. Openings for multiple conduits or cable tray shall be neatly saw cut 2 inches (50 mm) larger than required on all four sides to allow passage of the raceway components.

Insulation removed to clear the opening for the passage of raceway components through metal insulated wall panel shall be reinserted around the outside edges of the opening.

Openings through metal wall panel shall be finished and sealed as indicated on the drawings.

16920.3.1.6.5 Openings through roof. No roof openings shall be allowed for raceway components. Where raceway components must access equipment located on a roof, the opening shall be made on vertical portions of walls or parapets as specified herein. Openings shall be finished and sealed as indicated on the drawings.

16920.3.1.6.6 Openings into equipment. All openings beneath equipment and all openings into the top or sides of equipment in non air-conditioned areas, including pull boxes, shall be sealed to prevent the entry of dust and liquids. All sealing materials and installations shall be watertight and flame retardant, and shall be installed in accordance with the manufacturer's recommendations. The sealing installation shall be finished to provide a smooth, neat appearance. Openings shall not be sealed until all the cables passing through the opening have been installed and tested.

All sealing materials and installation methods shall be acceptable to the Engineer prior to installation.

All openings beneath equipment shall be sealed as indicated on the drawings. The seal shall provide for a minimum fire rating equal to the floor being penetrated. The cut edge of openings through metal decking beneath concrete floors for the passage of cables not enclosed in conduit shall be smooth to prevent damage to the cable.

All openings into the top or sides of equipment in non air-conditioned areas allowing for the passage of cable shall be sealed as indicated on the drawings. The seal shall provide a minimum fire rating of 2 hours.

Unused openings into the top or sides of equipment planned for the passage of cable shall be sealed by installing a gasketed plate over the unused opening and securing it to the equipment with stainless steel screws. The gasket and plate shall extend beyond the edges of the opening a minimum of 3/4 inch (19 mm) all around the entire opening. Unused openings into the top or sides of equipment planned for conduit shall be sealed by installing a threaded gasketed conduit hub over the conduit opening and inserting a threaded plug into the hub. The conduit hub shall be sized for the opening in the equipment and securely fastened to the equipment. Rubberized knockout plugs and snap-in steel blanks shall not be allowed.

16920.3.1.6.7 Fire stops. Sleeves and openings for the passage of cable and raceway through walls and floors shall be sealed with UL or Factory Mutual approved fire stops having a fire rating not less than that of the wall or floor penetrated.

All fire stops shall be installed in accordance with the manufacturer's recommendations, including installation by trained personnel when so recommended by the manufacturer.

All seals shall be finished to provide a smooth, neat appearance.

16920.3.1.7 Extensions of Building Steel to Support Raceway. Extensions of building structures to support raceway shall be of the same material as the structure being extended and shall be finished to match the finish of the extended structure.

16920.3.1.8 Beam Clamps. Beam clamps for attachment of hanger rods to structural steel beams shall be electrogalvanized steel and shall be provided with safety beam anchor straps. Swivels shall be provided where required to prevent bends in the hanger rods.

16920.3.1.9 Welding. Welds, welding, and related operations for fabrication of carbon and low alloy steel components shall be in conformance with Q100 - General Welding Requirements in Section 01400, and as specified herein.

Tack welds shall either be incorporated into, or removed from, the final assembly. Temporary welds used for erection, lifting lugs, etc., shall be removed and the area ground flush.

Weld spatter, including tightly adherent spatter, shall be removed from weld areas and the areas shall be prime painted or regalvanized.

All temporary supports which have been welded to the building shall be removed as promptly as possible. After removal, the roughened surface of the building steel shall be ground smooth and a protective primer paint applied equal to that which was initially applied.

16920.3.1.10 Use of Unfinished Conduit. Conduit runs including supports and connections shall be completed prior to the pull-in of conductor where the potential for conductor damage exists.

16920.3.1.11 Repair of Galvanized Surfaces. All galvanized surfaces on which the galvanizing is removed or damaged by cutting, drilling, or any other operation shall be regalvanized in accordance with ASTM A780.

16920.3.2 Raceway Installation Records

The Contractor shall maintain one set of conduit drawings in his central office at the jobsite as an as-built set. This as-built set shall contain all marks necessary to locate and identify raceway which is not installed in accordance with the Engineer's drawings.

The Contractor's as-built drawing set shall be available to the Engineer.

The Contractor's as-built record set shall be turned over to the Engineer after installation of all raceway is completed.

16920.3.3 Conduit Components

An electrical conduit system shall be furnished and installed in accordance with the drawings and the following specifications. Conduit components shall include conduit, fittings, supports, and hardware required for a complete system.

16920.3.3.1 Conduit Materials. Electrical conduit and associated component materials shall conform to the requirements of the articles that follow. Specific conduit component materials shall be as indicated on the drawings for their intended application.

16920.3.3.1.1 Rigid galvanized steel conduit. Steel conduit, couplings and elbows shall be a threaded hot-dipped galvanized rigid mild steel manufactured in accordance with ANSI/NEMA C80.1 and UL 6. The conduit interior and exterior surfaces shall have a continuous hot-dipped galvanized coating with a transparent overcoat of enamel, lacquer, or zinc chromate. Each length of conduit shall have a coupling on one end and a thread protector on the other. The thread protector shall have sufficient mechanical strength to protect the threads during normal handling and storage. Rigid galvanized steel conduit shall be similar to Type GRC as manufactured by Allied Tube and Conduit Corporation, or Engineer accepted equal.

16920.3.3.1.2 Not Used

16920.3.3.1.3 Rigid plastic conduit. Plastic conduit and elbows shall be unthreaded Schedule 80 polyvinyl chloride manufactured in accordance with NEMA TC-2 and UL 651. Rigid plastic conduit shall be as manufactured by Cantex, Inc. or Engineer accepted equal.

16920.3.3.1.4 Not Used

16920.3.3.1.5 Liquidtight flexible metallic conduit. Liquidtight flexible metallic conduit shall be a plastic jacketed, heavy-duty, locking, flexible metal core manufactured in accordance with ANSI/UL 360. The plastic jacket shall be UV, oil, and acid resistant and shall be suitable for a temperature rating of 60° C. The metal core shall be a locking galvanized steel core for use with galvanized conduit systems, or a locking aluminum core for use with aluminum conduit systems. Liquidtight flexible metallic conduit used in high temperature areas shall have a thermoplastic PVC jacket suitable for a temperature rating of 105° C. Galvanized liquidtight flexible metallic conduit shall be similar to Sealtite Type UA as manufactured by Anamet Canada, Inc. or Engineer accepted equal. High temperature galvanized liquidtight flexible metallic conduit shall be similar to Sealtite Type HTUA as manufactured by Anamet Canada, Inc. or Engineer accepted equal. Aluminum liquidtight flexible metallic conduit shall be similar to Sealtite Type EFL as manufactured by Anamet Canada, Inc. or Engineer accepted equal.

16920.3.3.1.6 Not Used

16920.3.3.1.7 Flexible metallic couplings. Flexible metallic couplings shall be prefabricated lengths of flexible conduit comprised of a bronze braided brass core and insulating wire duct manufactured in accordance with UL 886. The metallic coupling shall have prefabricated male connectors on both ends. Flexible metallic couplings shall be used in Class I, Div. 1 locations where a liquidtight flexible conduit connection is required. Flexible metallic couplings shall be similar to Type ECGJH as manufactured by O-Z/Gedney, or Engineer accepted equal.

16920.3.3.1.8 Rigid metal conduit bodies and fittings. Rigid metal conduit bodies and fittings shall conform to the requirements of ANSI/NEMA FB-1, UL 514B and UL 886 where these standards apply. Conduit bodies and fittings shall be appropriate for the area and equipment with which they are associated. Conduit bodies and fittings used in hazardous areas shall conform to NEC requirements for the area classification.

Threaded galvanized malleable iron or galvanized steel bodies and fittings shall be used with galvanized conduit. Threaded copper free aluminum or aluminum alloy bodies and fittings shall be used with aluminum conduit. Unthreaded zinc coated steel fittings shall be used with electrical metallic tubing. Metallic tubing fittings shall be compression type and watertight.

Additional requirements for rigid metal conduit bodies and fittings are as follows.

16920.3.3.1.8.1 Conduit outlet bodies. Conduit outlet bodies shall be provided where required for pulling ease and changing conduit direction. Standard conduit outlet bodies shall be threaded to accept threaded cover screws. Standard conduit outlet bodies installed outdoors or in wet locations shall be gasketed to provide a watertight seal. Conduit outlet bodies used in hazardous areas shall be provided with internally threaded gasketed covers.

Standard conduit outlet bodies shall be similar to Types LB, X, LL, LR, T, TB or C as manufactured by O-Z/Gedney, or Engineer accepted equal. Hazardous area conduit outlet bodies shall be similar to Type GUA as manufactured by O-Z/Gedney, or Engineer accepted equal.

16920.3.3.1.8.2 Insulated bushings. Insulated bushings with insulating inserts in metal housings shall be provided for the termination of all threaded conduits not terminated in hubs or couplings. Insulating inserts shall be phenolic or a similar thermoplastic material.

Grounding type insulated bushings shall be provided for all conduits containing power circuits and all conduits located in hazardous areas.

Insulated bushings shall be similar to Type IBC as manufactured by O-Z/Gedney, or Engineer accepted equal. Grounding type insulated bushings shall be similar to Type IBC-L-BC as manufactured by O-Z/Gedney, or Engineer accepted equal.

16920.3.3.1.8.3 Locknuts. Locknuts shall be provided for the termination of all indoor threaded conduits not terminated in hubs or couplings. One interior and one exterior locknut shall be provided. Exterior locknuts shall be gasketed. Locknuts shall be designed to securely bond the conduit to the box when tightened while also preventing loosening by vibration. Interior locknuts shall be similar to Type 1 as manufactured by O-Z/Gedney, or Engineer accepted equal. Exterior locknuts shall be similar to Type SLG as manufactured by O-Z/Gedney, or Engineer accepted equal.

16920.3.3.1.8.4 Unions. Conduit unions shall be provided for the connection of two threaded conduit ends when the conduit cannot be turned. Standard conduit unions shall be similar to three piece Type 4 Series as manufactured by O-Z/Gedney, or an acceptable equal. Hazardous area conduit unions shall be similar to Type UNF as manufactured by O-Z/Gedney, or an acceptable equal.

16920.3.3.1.8.5 Raintight hubs. Raintight hubs shall be provided for the termination of threaded conduits on outdoor equipment where threaded hubs are not provided. Raintight hubs shall be provided with an insulated throat. Standard raintight hubs shall be similar to Type CHM as manufactured by O-Z/Gedney, or Engineer accepted equal. Hazardous area raintight hubs shall be similar to Type EYH-SG as manufactured by O-Z/Gedney, or Engineer accepted equal.

16920.3.3.1.8.6 Combination fittings. Combination fittings shall be provided to connect threaded rigid metal conduit to electrical metallic tubing. Combination fittings shall have a threaded throat to receive the rigid metal conduit, and a threadless compression type throat to receive the electrical metallic tubing. Combination fittings shall be similar to Type ETR as manufactured by O-Z/Gedney, or Engineer accepted equal.

16920.3.3.1.8.7 Expansion fittings. Expansion fittings shall be provided in threaded conduit runs to allow for the expansion and contraction of conduit supported across expansion joints. Expansion fittings shall be watertight, and shall be provided with bonding jumpers. Standard expansion fittings shall be similar to Type EX as manufactured by O-Z/Gedney, or Engineer accepted equal. Expansion fittings for hazardous areas shall be similar to Type UNFE as manufactured by O-Z/Gedney, or Engineer accepted equal.

16920.3.3.1.8.8 Drains. Drains shall be provided in the low spots of outdoor conduit runs, and in outdoor conduit runs prior to entering buildings, to remove condensation from the conduit. Conduit drains shall be similar to Type DB as manufactured by O-Z/Gedney, or Engineer accepted equal.

16920.3.3.1.8.9 Reducers. Reducers shall be provided to connect two different conduit sizes together. Reducers shall be external couplings similar to Type REC as manufactured by Crouse-Hinds, or Engineer accepted equal.

16920.3.3.1.8.10 Seal-off fittings. Seal-off fittings shall be provided to isolate conduit runs and prevent the passage of flammable gases, vapors, and dusts from hazardous areas. Seal-off fittings shall be suitable for vertical and horizontal conduit installations. Seal-off fittings shall have a removable plug for the placement of sealing fiber, and an additional removable plug for the placement of sealing compound. Seal-off fittings shall be similar to Type EYA as manufactured by O-Z/Gedney, or Engineer accepted equal.

Sealing fiber and sealing compounds shall be compatible with the seal-off fittings provided.

16920.3.3.1.9 Liquidtight flexible metallic conduit fittings. Liquidtight flexible metallic fittings shall be provided to connect liquidtight flexible metallic conduit to rigid metal conduit and devices. Liquidtight flexible metallic fittings shall have insulated throats and shall bear the UL label. Liquidtight flexible metallic fittings shall be similar to Type STB and Type STN as manufactured by Appleton, or Engineer accepted equal. Galvanized malleable iron fittings shall be used with galvanized core flexible conduit. Copper free aluminum or aluminum alloy fittings shall be used with aluminum core flexible conduit.

16920.3.3.1.10 Not Used

16920.3.3.1.11 Rigid plastic conduit bodies and fittings. Rigid plastic conduit bodies and fittings shall be polyvinyl chloride and shall conform to the requirements of NEMA TC-3, NEMA TC-9, and UL 514B where these standards apply. Plastic conduit bodies and fittings shall be of the same schedule or type composition as the plastic conduit attaching to. Plastic conduit bodies and fittings shall use unthreaded solvent cement type joints. Plastic conduit couplings shall have center stops to ensure proper seating. Plastic conduit outlet bodies shall have gasketed screw type covers.

Spacers for underground rigid plastic conduit shall be plastic interlocking base and intermediate type spacers. The spacers shall have voids or openings to allow for the flow of concrete along the conduit, thus eliminating any hollow area within the concrete. The separation distance between the outer walls of all conduit interlocked together shall be as indicated on the drawings.

Plastic conduit bodies and fittings shall be as manufactured by Cantex, Inc., or Engineer accepted equal.

16920.3.3.2 Conduit Supports. Conduit supports shall conform to the requirements of the articles that follow. Specific conduit support materials shall be as indicated on the drawings.

16920.3.3.2.1 Hanger rods. Hanger rods used for the support of formed channel shall be 1/2 inch (13 mm) diameter electrogalvanized continuous threaded steel rods. Hanger rods shall be similar to Type HTHR as manufactured by Unistrut Metal Framing, or Engineer accepted equal.

16920.3.3.2.2 Support channel. Support channel shall be hot-dipped galvanized formed channel made from 12 gauge steel in 1-5/8 inch (41 mm) series sizes. Support channel shall be similar to Type P1000 Series as manufactured by Unistrut Metal Framing, or Engineer accepted equal.

16920.3.3.2.3 Support channel fittings. Support channel fittings shall be flat plate and angular fittings and brackets designed for use with the 1-5/8 inch (41 mm) series formed channel indicated previously. Support channel fittings shall be hot-dipped galvanized steel. Support channel fittings shall be as manufactured by Unistrut Metal Framing, or Engineer accepted equal.

16920.3.3.2.4 Conduit clamps. Conduits in single runs or groups of two shall be supported by one hole cast metal clamps with clamp backs, or with conduit clamps attached to beams. One hole clamps, clamp backs and conduit clamps attached to beams shall be hot-dipped galvanized malleable iron. One hole conduit clamps and clamp backs shall be similar to Type 14-G Series manufactured by O-Z/Gedney, or Engineer accepted equal. Conduit beam clamps shall be similar to Types UBC, UEC, and UPC manufactured by O-Z/Gedney, or Engineer accepted equal.

Supports for banks of three or more conduits shall be constructed of formed channel with associated two piece galvanized conduit clamps. Two piece conduit clamps shall be designed for use with the 1-5/8 inch (41 mm) series formed channel indicated previously. Two piece conduit clamps shall be similar

to Type P1100 Series or Type P1400 Series manufactured by Unistrut Metal Framing, or Engineer accepted equal.

Conduits in single runs or groups of two terminated at cable tray shall be supported from the tray side rail using galvanized malleable iron cable tray conduit clamps similar to Type LCC Series clamps manufactured by Crouse-Hinds, or Engineer accepted equal. Banks of three or more conduits shall be terminated at cable tray with the use of two piece conduit clamps and formed channel attached to the tray side rail as indicated on the drawings.

16920.3.3.3 Conduit Installation. Conduit and associated components shall be installed as indicated on the drawings and as described in these specifications. The following installation requirements are in addition to the requirements indicated in Article 16920.3.1.

16920.3.3.3.1 Routing. Field routed conduit and associated supports shall not interfere with the installation or maintenance of any dimensioned equipment, building steel, cable tray, HVAC duct, fans, dampers, or prerouted piping.

Conduit shall not be routed under crane or trolley rails, or through areas designated for the maintenance or removal of equipment accessed by overhead removable panels and hatches. Any conduit which interferes with these areas or purpose shall be promptly removed so as not to delay installation or use of any equipment.

Except as otherwise specified or indicated on the drawings, all conduit shall be installed in exposed runs parallel or perpendicular to dominant surfaces with right angle turns made of symmetrical bends or fittings. Except where prevented by the location of other work, a single conduit or a conduit group shall be centered on structural members.

16920.3.3.3.2 Conduit drains. Outdoor conduits shall not contain moisture pockets. Drains shall be installed in outdoor conduit to remove moisture at locations where conduits terminate on equipment or devices, and at locations where conduits penetrate an exterior wall.

Outdoor conduits shall be installed so that water will not drain into any equipment containing electrical devices or connections. Drains shall be installed at lowest point in conduit above grade. Outdoor conduits terminating on equipment from above shall have a conduit seal fitting with drain installed in the conduit run near the conduit termination where practical. Outdoor conduit terminating on equipment from the side shall have a conduit "tee" body with drain installed in the conduit run near the conduit termination where practical. Outdoor conduit terminating on equipment from below shall have a conduit "tee" body with drain installed in the conduit run at the lowest vertical location directly below the equipment. Equipment serviced from below by underground or embedded conduits shall not require drains.

Outdoor conduits penetrating exterior walls shall have a conduit "tee" body with drain installed on the exterior side of the wall at the "low point" of the conduit as close as practical to the wall penetration.

16920.3.3.3.3 Couplings and unions. Rigid metal conduit shall be joined by threaded conduit couplings with the conduit ends butted. The use of running threads will not be permitted. Where rigid metal conduit cannot be turned and joined together by standard threaded couplings, conduit unions or split couplings may be used. Conduit union coupling nuts shall be installed uppermost on vertical or inclined conduit runs to prevent the entrance of water into the union. Split couplings shall not be installed on outdoor conduit.

Plastic conduit shall be joined together in accordance with manufacturer recommendations using unthreaded couplings and a medium bodied solvent cement. Joining surfaces shall be wiped clean of dirt, moisture, or other contaminants prior to application of the solvent cement. If joining surfaces are

extremely dirty or coated with oil, a cloth saturated with PVC cleaner shall be used to clean the surfaces. Joining surfaces shall be thoroughly dried before applying solvent cement.

Electrical metallic tubing shall be joined together by unthreaded compression couplings. The use of set-screw couplings will not be permitted.

16920.3.3.3.4 Bends and offsets. A run of conduit shall not contain more than the equivalent of four 90 degree bends, including those immediately at outlet bodies and fittings. Field bends shall be made without reducing the internal diameter of the conduit. The center line radius of field bends shall not be less than six times the nominal trade size diameter of the conduit.

The use of a pipe tee or vise for bending metal conduit will not be permitted.

Plastic conduit bends shall be factory fabricated wherever possible. Where field bending of plastic conduit is required, the conduit length shall be heated to approximately 275° F. Conduit heating may be by radiant heat, hot air, or hot liquid immersion. Open flame heating will not be permitted. Special mandrels or forms shall be used to provide a smooth bend without reduction of the conduit diameter. Conduit discolored by prolonged heating will not be acceptable.

16920.3.3.3.5 Fittings. Conduit outlet bodies installed in conduit runs shall be sized and installed in accordance with the NEC. Covers shall be installed on outlet bodies at the time of installation to prevent the entrance of moisture or contaminants into the conduit system prior to cable pulling operations.

Conduit outlet bodies shall not be installed in conduit runs containing 5 kV and higher voltage conductors, unless the type and location have been reviewed for excessive cable bending radius constraints as defined by the cable manufacturer.

Conduit fittings for metal conduit shall be installed wrenchtight.

Hazardous area conduit seal-off fittings shall be installed at locations required by the NEC for the classified area. Seal-off fitting compounds and fiber shall be installed as recommended by the fitting manufacturer. Completed conduit seal-off fitting installations shall not restrain equipment removal or access beyond that which would be encountered if there were no sealing fitting installed on the conduit run.

16920.3.3.3.6 Cutting and threading. The plane of all conduit ends shall be square and perpendicular with the center line. The ends of all conduit and tubing shall be reamed to remove all rough edges and burrs.

Where threads are required, they shall be cut and cleaned prior to conduit reaming. A cutting oil shall be used in threading operations. The dies shall be kept sharp and provisions shall be made for chip clearance.

All steel conduit ends, after cutting or threading, shall be regalvanized using a cold galvanizing zinc rich coating.

16920.3.3.3.7 Connections to boxes and cabinets. Conduit shall be securely fastened to all boxes and cabinets. Threads on metallic conduit not terminated in threaded hubs shall project through the wall of the box or cabinet to allow the bushing to butt against the end of the conduit. The locknuts both inside and outside shall then be tightened sufficiently to bond the conduit securely to the box or cabinet. Locknuts on EMT box connectors shall be tightened securely to bond the connectors to the box or cabinet.

All conduit terminating on boxes or cabinets located outdoors, or terminating on indoor NEMA 12, NEMA 4, or NEMA 4X enclosures, shall terminate with raintight conduit hubs or threaded hubs provided with the enclosure. Gasketed sealing type locknuts may be used in lieu of threaded hubs for connections to indoor NEMA 12 enclosures.

If the conduit connected to the equipment exceeds the number or size of threaded hubs supplied with the equipment, additional material shall be furnished and installed as required to connect the conduit to the equipment.

16920.3.3.3.8 Cleaning. Precautions shall be taken to prevent the accumulation of water, dirt, or concrete in the conduit. Conduit in which water or other foreign materials have been permitted to accumulate shall be thoroughly cleaned.

16920.3.3.3.9 Liquidtight flexible conduit. Liquidtight flexible conduit inserts shall be installed at the locations indicated below. Liquidtight flexible conduit lengths shall not be greater than 24 inches (600 mm) in length for 2 inch (50 mm) and under nominal conduit diameter, and 48 inches (1200 mm) in length for nominal conduit diameter greater than 2 inches (50 mm)

Liquidtight flexible metallic conduit shall be installed in all rigid metal conduit runs which are supported by both building steel and by structures subject to vibration or thermal expansion. This shall include locations where conduit supported by building steel enters or becomes supported by the turbine generator foundation and where conduit supported by building steel or foundation becomes supported by steam generator framing.

Liquidtight flexible metallic conduit shall be installed in rigid metal conduit runs which cross expansion joints or which connect to building supported independent structures, such as heat exchangers, storage tanks, or ash hoppers.

Liquidtight flexible metallic conduit should be considered in all long rigid metal conduit runs where differential expansion problems may be expected.

Liquidtight flexible metallic conduit shall be installed adjacent to all equipment and devices which move in relation to the supply conduit due to vibration, normal operation of the mechanism, or thermal expansion.

The supply conduit shall be connected to pressure switches, thermocouples, solenoids, and similar devices with liquidtight flexible metallic conduit. Liquidtight flexible metallic conduit shall be installed adjacent to the motor terminal housing for motors requiring 4 inch (100 mm) and smaller conduit. Provisions for vibration and thermal expansion at motors requiring larger than 4 inch (100 mm) conduit shall be accomplished by use of pendent hangers or other acceptable means.

16920.3.3.3.10 Not Used

16920.3.3.3.11 Plastic conduit. Plastic conduit shall be installed in accordance with the installation requirements previously specified for rigid metal conduit. Expansion joints shall be provided as recommended by the manufacturer.

16920.3.3.3.12 Below grade conduit. Below grade conduit shall be rigid galvanized steel or rigid plastic conduit as indicated on the drawings.

Below grade conduit shall be routed as closely as possible to the general routing and elevations indicated on the drawings.

Conduit riser elbows shall use rigid galvanized steel conduit and shall be concrete encased.

Conduit riser extensions shall be rigid galvanized steel with rigid steel main conduit runs, and may be rigid galvanized steel or rigid plastic conduit with rigid plastic main conduit runs. Conduit riser extensions shall be concrete encased. Conduit riser extensions shall terminate 6 inches (150 mm) above finished building floors or finished grade elevations in yard areas. Conduit extensions shall be straight and plumb, plugged prior to pouring of concrete, and remain plugged until conduit is extended later or readied for cable pulling operations. Plugs shall be either threaded plastic or threaded metal inserts.

Concrete used for encasing below grade conduit shall conform to the requirements of Section 03311 - Cast-in-Place Concrete of these specifications. The concrete shall be vibrated to consolidate it around the conduit and shall be slow cured for several days to provide strength and prevent shrinkage.

Below grade conduit shall be accurately positioned and supported for encasement by plastic conduit spacers set in the conduit trench, or by steel wire hangers attached to temporary supports laid across the conduit trench. After the concrete encasement has hardened, the temporary supports and the exposed portions of the steel wire hangers not encased in concrete shall be removed.

Warning tape shall be placed in a trench directly over direct buried conduit and direct buried cable.

The following requirements also apply to below grade conduit.

16920.3.3.3.12.1 Rigid galvanized steel conduit. Rigid galvanized steel conduit shall not be directly buried in the earth. Single runs of below grade rigid galvanized steel conduit shall be encased with 3 inches (75 mm) of concrete between the conduit outer walls and earth. Multiple runs of below grade rigid galvanized steel conduit shall maintain a minimum 2 inch (50 mm) separation between adjacent conduits to allow for concrete placement. Multiple runs of rigid galvanized steel conduit shall also be provided with 3 inches (75 mm) of concrete encasement between the conduit outer walls and earth.

16920.3.3.3.12.2 Rigid plastic conduit. Below grade rigid plastic conduit shall not require concrete encasement, except where roadway crossings or construction traffic warrant its use for strength and physical protection. Where indicated on the drawings, concrete encasement for plastic conduit shall have the same spatial and envelope requirements as rigid galvanized steel conduit.

Where rigid plastic conduit is directly buried in the earth, it shall be laid in a graded 3 inch (75 mm) deep bedding of sand or other finely divided job excavated material free from debris, organic material, and stones. After placement on the bedding, the conduit shall be covered with backfill to 6 inches (150 mm) above the conduit. The backfill shall be of the same material as the bedding. Backfill shall be compacted to meet density requirements of the surrounding earth.

16920.3.3.3.13 Conduit support spacing. All conduit runs shall be rigidly supported in accordance with the NEC and the following requirements.

Vertical rigid metal conduit shall be supported in maximum 20 foot (6 m) intervals. Vertical plastic conduit and electrical metallic tubing shall be supported at the maximum intervals indicated for their respective horizontal conduit support spacing shown below.

Rigid metal conduit, plastic conduit, and electrical metallic tubing shall be supported within 3 feet (900 mm) of each junction box, pull box, cabinet, conduit body, or other conduit termination.

Horizontal rigid metal conduit, plastic conduit, and electrical metallic tubing shall be supported at the indicated maximum intervals.

Maximum Support Intervals			
Nominal Conduit Size, inches	Rigid Metal Spacing, feet	Rigid Plastic Spacing, feet	Electrical Metallic Tubing Spacing, feet
1/2	10	3	5
3/4	10	3	5
1	12	3	6
1-1/2	14	5	7
2	16	5	8
2-1/2	16	6	8
3	20	6	10
4	20	7	10
5	20	7	-
6	20	8	-

16920.3.3.3.14 Conduit identification. All conduit shall be clearly identified with its raceway number as indicated on the drawings, except for lighting, receptacle, and communication conduits. Conduit identification shall be with Electromark Co. Type C-1003 markers or Engineer accepted equal, covered with clear wraparound bands. Markers shall be positioned so that they are easily read by personnel standing on the floors and walkways. Markers shall be installed on each end of conduits which are in excess of 10 feet (3 m), and at only one end of conduits which are 10 feet (3 m) or less in length.

16920.3.4 Not Used

16920.3.5 Junction Boxes and Pull Boxes

All boxes required throughout the electrical raceway system shall be furnished and installed in accordance with the drawings and the requirements which follow.

16920.3.5.1 Junction Box and Pull Box Materials. Junction boxes and pull boxes shall be constructed in accordance with UL 50 and NEMA for their intended service. Junction boxes and pull boxes shall not have knockouts.

Enclosure type, material, and dimensions shall be as indicated on the drawings and as specified in these specifications. Where no type or size is indicated elsewhere for junction boxes and pull boxes, they shall be in accordance with the requirements of the NEC, Article 314.

Unless indicated otherwise, enclosure types shall be as follows:

Location	Enclosure Type	
	Junction Boxes	Pull Boxes
Indoor (nonhazardous)		
Conditioned rooms	NEMA 1	NEMA 1
Process areas (dry)	NEMA 12	NEMA 12
Process areas (wet)	NEMA 4	NEMA 12

Location	Enclosure Type	
	Junction Boxes	Pull Boxes
Corrosive areas	NEMA 4X	NEMA 4X
Outdoor (nonhazardous)		
Noncorrosive areas	NEMA 4	NEMA 3R
Corrosive areas	NEMA 4X	NEMA 4X
Hazardous areas		
Class I, Division 1	NEMA 7*	NEMA 7*
Class I, Division 2	NEMA 7*	NEMA 12 (indoor) NEMA 3 (outdoor)
Class II, Division 1	NEMA 9*	NEMA 12 (indoor) NEMA 3 (outdoor)
Class II, Division 2	NEMA 12 (indoor) NEMA 3 (outdoor)	NEMA 12 (indoor) NEMA 3 (outdoor)
Class III	NEMA 12 (indoor) NEMA 4 (outdoor)	NEMA 12 (indoor) NEMA 3 (outdoor)
Note: * indicates an alpha character identified by the Group designation associated with the known suspended hazard in the air as identified in the National Electrical Code.		

Junction boxes and pull boxes 4 inch (100 mm) trade size or smaller in any dimension shall be galvanized malleable iron or acceptable equal cast ferrous metal for use with threaded, galvanized steel conduit. Copper free aluminum or aluminum alloy boxes shall be used with threaded aluminum conduit. Galvanized steel boxes shall be used with electrical metallic tubing.

Junction boxes and pull boxes larger than 4 inch (100 mm) trade size, and having a depth of not over 24 inches (600 mm), shall be constructed from manufacturer's standard gauge phosphatized sheet steel. The surfaces of the steel shall be finish coated inside and out after fabrication, in accordance with manufacturer's standard.

Pull boxes having a depth greater than 24 inches (600 mm) shall be constructed from steel plate reinforced as required to provide true surfaces and adequate strength to support a concentrated load of 200 pounds on the top after erection. The pull box surface shall be finish coated inside and out after fabrication, in accordance with the manufacturer's standard.

16920.3.5.2 Outlet Boxes and Switch Boxes. All outlet boxes, switch boxes, and associated fittings shall be constructed in accordance with UL 514.

All surface mounted outlet boxes, switch boxes, and associated fittings shall be galvanized malleable iron or Engineer accepted equal cast ferrous metal for use with threaded steel conduit. Copper free aluminum or aluminum alloy boxes shall be used with threaded aluminum conduit. Galvanized steel boxes shall be used with electrical metallic tubing.

16920.3.5.3 Installation. Cabinets and boxes shall be rigidly mounted. Mounting on concrete shall be by post-installed mechanical anchors. Mounting on steel shall be by drilled and tapped screw holes, or by special support channels welded to the steel, or by both. Cabinets shall be leveled and fastened to the

mounting surface with not less than 1/4 inch (6 mm) air space between the enclosure and mounting surface. All mounting holes in the enclosure shall be used.

Except as prevented by the location of other work, all junction boxes, pull boxes, and outlet boxes shall be centered on structures.

Conduit openings in boxes shall be made with a hole saw or shall be punched. All unused threaded openings shall be sealed with threaded plugs.

16920.3.5.4 Pull Box and Junction Box Identification. The identification number indicated on the drawings for each junction box and pull box having a depth greater than 24 inches (600 mm) shall be stenciled on the cover of the box or engraved on a Phenolic tag and attached to the box. The lettering shall be block type and shall be not less than 1 inch (25 mm) high.

The identification number of each junction box and pull box having a depth of 24 inches (600 mm) and smaller shall be engraved on a phenolic nameplate and attached to the box. Nameplates attached to pull boxes and junction boxes in finished areas may be fastened using adhesive tape. For all other areas, nameplates shall be fastened using suitable hardware.

16920.3.6 Not Used

16920.3.7 Not Used

16920.3.8 Grout

Grout shall be as specified in Section 03611 - Grouting, and modified as follows:

Nonshrinking grout shall be used whenever the space to be grouted has a thickness of 2 inches (50 mm) or more and free placement of grout will not be hampered. Fifty pounds (23 kg) of pea gravel may be added to each 100 pounds (45 kg) of grout materials.

Grout shall be placed in strict accordance with the directions of the manufacturer to completely fill the openings without voids.

16925 - Conductors Installation

16925.1 General

This section covers the installation of cable, conductors, and accessories. Insulated cable, conductors, and conductor accessory installation shall be in accordance with the cable manufacturer's recommendations, the drawings, and these specifications.

Installation shall be defined to include purchasing; unloading; storage; placement; splicing; terminating conductors; coiling and taping of spare conductors; and identification, testing, and verification of each circuit, cable, and conductor. Installation of cable in existing trays shall also include removal and replacement of existing cable tray covers.

Terminating a conductor shall include installing cable termination kits for shielded cable, attaching the conductor at its designated location, and insulating the entire connection where specified or required by the application.

Phase tape shall be applied to each conductor at the terminations of all power and lighting circuits that are not already properly color coded.

16925.1.1 Scope of Supply

Unless otherwise specified as being furnished by others, the Contractor, shall furnish all conductors (including grounding and lightning protection conductors), terminations, fittings, splices, lubricants, equipment, and miscellaneous materials as required for a complete conductor installation.

16925.1.2 Not Used

16925.1.3 Performance and Design Requirements

Performance and design requirements for the equipment to be furnished under this article of these specifications are indicated herein.

16925.1.4 Codes and Standards

Work performed under these specifications shall be done in accordance with the following codes and standards. Unless otherwise specified, the applicable governing edition and addenda to be used for all references to codes or standards specified herein shall be interpreted to be the jurisdictionally approved edition and addenda. If a code or standard is not jurisdictionally mandated, then the current edition and addenda in effect at the date of this document shall apply. These references shall govern the work except where they conflict with the Owner's specifications. In case of conflict, the latter shall govern to the extent of such difference:

Work	In Accordance With
Cable Installation	IEEE 1185, IEEE 336 (Nuclear), IEEE P690 (Nuclear), ANSI/NECA/BICSI 568
Splicing/Terminating	IEEE 404, UL 486A, UL 486C, ASTM F1836, ANSI/NECA/BICSI 568
Field Testing	IEEE 400, ANSI/TIA/EIA-568B

All circuits and cable components shall be installed in accordance with the applicable requirements of NFPA 70 - National Electrical Code. All materials and devices shall be in accordance with the applicable requirements of the Federal "Occupational Safety and Health Standards."

16925.1.5 Materials

The following materials shall be used:

Component	Material
Cables	Materials as indicated herein or in the technical attachments, Article 16925.1.8
Cable Accessories	As indicated in Article 16510.2.3
Cable Pulling Lubricant	As recommended by cable manufacturer

16925.1.6 Approved Manufacturers of Components

For the following components, only the listed manufacturers are recognized as maintaining the level of quality of workmanship required by these specifications. If the Contractor wants to propose a nonlisted manufacturer that is considered to provide an equivalent level of quality, this manufacturer must be identified and supporting testimony provided. Acceptance of the manufacturer as a substitute is at the discretion of the Engineer:

Component	Manufacturer
ICEA/UL Low Voltage Power Cable	General Cable, Prysmian (Pirelli), Rockbestos Suprenant, Rome, Southwire, Service Wire, Tamaqua (Draka USA), Kerite, Okonite
ICEA/UL control cable	Belden, Dekoron, General Cable, Prysmian (Pirelli), Rockbestos Suprenant, Southwire, Shawflex, Service Wire, Tamaqua (Draka USA), Okonite
ICEA/UL Instrumentation and Thermocouple Cable	Belden, Dekoron, General Cable, Shawflex
ICEA/UL insulated ground cable	General Cable, Essex/Royal, Okonite, Rockbestos Suprenant, Southwire, BIW Tamaqua
Lighting and Specialty Cable	As indicated in the technical attachments, Article 16925.1.8

16925.1.7 Test Requirements

The following testing shall be conducted in accordance with the specified source.

This testing is to be considered part of the defined Scope of Work, and all associated costs are the responsibility of the Contractor.

Tests	In Accordance With	Conducted By
Tests after placement	Articles 16925.3.5 and 16925.3.7	Contractor

16925.1.8 Not Used

16925.1.9 Supplemental Specifications

Technical supplemental specifications that are applicable to the work covered under this technical specification section are identified and included in Section 01400.

16925.1.10 Certification Requirements

Certified test reports for each type of power cable furnished under this Contract shall be provided in accordance with the requirements of AEIC CS8 and ICEA S-97-682 (ICEA/AECI MV power cable), and in accordance with the requirements of ICEA S-95-658 (ICEA/UL LV power cable) and other applicable standards as indicated in the technical attachments, Article 16925.1.8.

16925.2 Products

Conductors and accessories shall be furnished in accordance with the requirements of 16510 – Conductors and Accessories.

16925.3 Execution

16925.3.1 Not Used

16925.3.2 Cable Placement

All cable described in the Drawings shall be routed as indicated therein.

Cable shall not be handled when the cable temperature is below the minimum temperature recommended by the manufacturer. If cable heating is required prior to placement, the cable shall be stored in a heated building in accordance with the manufacturer's recommendations for at least 24 hours. Cable shall be placed the same day it is removed from heated storage.

If at any time during the progress of the work the Contractor finds raceways which appear inadequate to accommodate the assigned cable, he shall notify the Engineer at once and shall discontinue any further work on the questionable raceway until advised by the Engineer as to how he shall proceed.

All cable shall be carefully checked both as to size and length before being pulled into conduits or ducts. Cable pulled into the wrong conduit or duct or cut too short to rack, train, and splice as specified herein shall be removed and replaced. Cable removed from one conduit or duct shall not be pulled into another conduit or duct without prior approval from the Engineer.

16925.3.2.1 Cable in Trays. All cable shall be carefully laid in or pulled through the tray system so that neither the cable nor the trays are damaged. Cable may be laid along the side of the tray system during placement provided it is protected from dirt, water, oil, or other detrimental materials and from mechanical injury. Cable shall be cut sufficiently long to conform to the contour of the trays, with particular attention paid to vertical inside bends. All excessive slack shall be removed from the cable so that it lies parallel to the sides of the trays. Multiple single conductor cable which constitutes a single power circuit shall be grouped together as defined by the NEC to minimize magnetic influence on other cable in the area.

Power cables shall be installed in tray in accordance with the NEC and the following additional requirements:

Low Voltage Power Cables (2000 volts or less)

Multiconductor power cables less than 4/0 AWG may be installed in a random manner in accordance with NEC Article 392.9 (A)(2) and (3).

Low voltage multi-conductor power cables shall be installed in cable tray in a single layer with a maintained spacing of not less than one cable diameter between cables.

The cable shall be tied to the trays with nylon ties as necessary (but at not greater than 10 foot intervals) to hold it in place.

16925.3.2.2 Cable in Manholes. Cable shall be supported at all times without short bends or excessive sags and shall not be permitted to lie on the manhole floor. Cable ends must not be submerged. Cable racks or trays shall be provided for permanent support. Temporary support required during placement shall be with rope slings, timbers, or alternate methods acceptable to the Site Construction Manager.

16925.3.2.3 Cable Pulling. Fishing and pulling shall be done with flexible metal tape, CO₂ propelled polyethylene cord, nylon rope, or manila rope.

Unless specified otherwise or acceptable to the Engineer, cable shall not be pulled in a single pull through two sections of raceway connected by a manhole or pull box. Cable shall be pulled out at each manhole and pull box to the length required for termination. Prior to repulling of the pulled out cable, the cable shall be thoroughly inspected, cleaned, and relubricated. Damaged cable shall be removed and replaced.

Cable may be pulled in a single pull through two sections of raceway connected by a manhole or pull box only if it can be determined by calculation to the satisfaction of the Engineer that the pulling tension will not exceed the maximum tension allowed by the cable manufacturer.

Cable shall not be pulled using trucks, forklifts, cranes, or other devices where the tension of the cable pull cannot be easily controlled.

16925.3.2.4 Cable Grips. Factory installed pulling eyes shall be used for pulling cable where they are available. Woven wire cable grips shall be used to pull all single conductor cable 2/0 AWG (70 mm²) and larger, where pulling eyes are not available, and all multiconductor cable. Pulling loops shall be used to pull single conductor cable smaller than 2/0 AWG (70 mm²). All sharp points and edges on the hardware attaching the pulling rope to the cable shall be taped to prevent snagging or damaging the raceway.

When a cable grip or pulling eye is used for pulling, the area of the cable covered by the grip or seal plus 6 inches (150 mm) shall be cut off and discarded when the pull is completed. When pulling loops are used, the entire loop shall be cut off and discarded when the pull is completed.

As soon as the cable is pulled into place, the pulling eyes, cable grips, or pulling loops shall be removed and any cable which was sealed shall be resealed.

16925.3.2.5 Swivels. A reliable nonfreezing type of swivel, or swivel connection, shall be inserted between the pulling rope and the cable pulling eye, grip, or loop to prevent twisting under strain.

16925.3.2.6 Pulling Lubricants. Only lubricants recommended by the cable manufacturer and acceptable to the Engineer shall be used. Lubricants shall be applied liberally and continuously during the pull.

16925.3.2.7 Inspection. The outside of each cable reel shall be carefully inspected and protruding nails, fastenings, or other objects which might damage the cable shall be removed. A thorough visual inspection for flaws, breaks, or abrasions in the cable sheath shall be made as the cable leaves the reel, and the pulling speed shall be slow enough to permit this inspection. Damage to the sheath or finish of the cable shall be sufficient cause for rejecting the cable. Cable damaged in any way during installation shall be replaced.

16925.3.2.8 Pulling Tension. The pulling tension of any cable shall not exceed the maximum tension recommended by the cable manufacturer. Pulling mechanisms of both the manual and power types used

by the Contractor shall have the rated capacity in tons clearly marked on the mechanism. If any excessive strain develops, the pulling operation shall be stopped at once and the difficulty determined and corrected.

16925.3.2.9 Sidewall Pressure. To avoid insulation damage from excessive sidewall pressure at bends, the pulling tension in pounds shall not exceed the cable manufactures recommendation.

16925.3.2.10 Cable Bends. Tape shielded, flat tape armored, and wire armored cable shall not be bent to a radius of less than 12 times the overall cable diameter. All other cables shall not be bent to a radius of less than 8 times the cable diameter.

16925.3.2.11 Supports. All cable supports and securing devices shall have bearing surfaces located parallel to the surfaces of the cable sheath and shall be installed to provide adequate support without deformation of the cable jackets or insulation.

Adequate cable end lengths shall be provided and properly placed in junction boxes and manholes to avoid longitudinal strains and distorting pressures on the cable at conduit bushings and duct end bells.

Final inspection shall be made after all cable is in place and, where supports or raceway fittings deform the cable jacket, additional supports shall be provided. Additional cable protection such as a wrapping of light rubber belting, friction tape, or similar material shall be provided where required.

Cable in vertical runs shall be supported by woven wire grips in accordance with the NEC requirements, except that the distance between supports shall conform to the following:

Vertical Cable Support Spacing		
Conductor Size	Aluminum Conductor	Copper Conductor
1/0 AWG (50 mm ²) and smaller	150 feet (45 m)	100 feet (30 m)
2/0 AWG (70 mm ²) through 500 kcmil (240 mm ²)	100 feet (30 m)	50 feet (15 m)
Larger than 500 kcmil (240 mm ²)	70 feet (21 m)	30 feet (9 m)

16925.3.2.12 Cable Racks. Where cable trays are not specified in manholes, cable racks shall be furnished and installed according to the drawings and as required to provide the proper cable support. Cable racks shall be installed on spacings of not greater than 36 inches (900 mm) and shall be bolt secured to permanent wall surfaces with self-drilling anchors or continuous slot concrete inserts.

16925.3.2.13 Spare Conductors. All spare conductors of a multiconductor cable shall be left at their maximum lengths for possible replacement of any other conductors in the cable. Each spare conductor shall be neatly dressed for future use.

16925.3.2.14 Lacing. Nylon ties shall be used to neatly lace together conductors entering switchboards and similar locations after the conductors have emerged from their supporting raceway and before they are attached to terminals.

16925.3.2.15 Cable Identification. The ends of all circuits shall be identified with a circuit tag.

Each marker shall bear the number of the circuit according to the drawings.

At terminations, the Contractor shall identify each circuit. Each phase of multiphase power circuits shall be individually identified.

The circuit tag shall be so attached that it is readily visible for circuit identification.

Phase tape shall be applied to each conductor at the terminations of all power and lighting circuits. The phase taping for power conductors shall be as follows:

208/120 V Circuits	Black – Phase A; Red – Phase B; Blue – Phase C; White – Neutral
480/277 V Circuits	Brown – Phase A; Orange – Phase B; Yellow – Phase C; Grey – Neutral

Green shall be used for ground at every voltage level. Phase taping circuits shall not be required if cable with colored insulation is installed.

16925.3.2.16 Moisture Seals.

The ends of all power cables shall be sealed with heat shrinkable caps for circuits larger than #10 AWG. Circuits #10 AWG and smaller can be sealed with heat shrinkable caps or electrical tape. Cap sizes shall be as recommended by the cap manufacturer for the cable OD and insulation. Caps shall contain sufficient adhesive that shrinkage of the cap during application results in formation of a positive watertight seal capable of withstanding complete immersion or total exposure without permitting the entrance of moisture. Heat shrinkable caps shall be "Thermofit" as manufactured by Raychem Corporation or Engineer acceptable equal.

Before and after pulling, the leading end seal of each length of cable shall be examined and repaired if necessary. All cut cable ends shall be promptly sealed after cutting except those to be spliced or terminated immediately.

16925.3.2.17 Not Used

16925.3.2.18 Internal Panel Wiring and Jumpers. Internal panel wiring and jumpers shall be installed in accordance with the drawings, schematic and wiring diagrams, three-line diagrams, one-line diagrams, and as required for a complete functional operation of the system or equipment.

Wire markers shall be installed at each end of each jumper, not within the same or immediate adjacent terminal blocks, using slip-on wire markers. The wire markers shall contain the opposite end designation of the jumper. Jumper wire notations shall be acceptable to the Engineer.

Jumpers if required, are identified on the drawings.

16925.3.3 Splices

No splices shall be made in conductors for instrument circuits or control circuits, unless indicated on the drawings, except where required at connections to accessory devices equipped with factory installed pigtails or where high temperature wire is necessary locally to connect to a particular device. Shields may be spliced where necessary to permit connection to the station ground.

Power cable circuits may not be spliced unless specifically approved by the Engineer. Where splices are unavoidable, they shall be performed in accordance with the standards listed in this section and at locations acceptable to the Engineer.

Splices shall not be made to utilize short lengths of cable nor shall they be made to provide correct lengths on cable initially cut too short for a particular circuit.

Splices, joints, and connections in cable shall be made only in pull boxes or junction boxes unless otherwise indicated on the drawings and shall be made in accordance with the instructions of the cable manufacturer.

Splices in cable shall be prepared and insulated in a manner similar to the cable terminations specified below.

16925.3.4 Terminations

Cable shall be terminated in accordance with the following requirements:

Train cable in place and cut squarely to required length. Avoid sharp bends.

Remove necessary amount of cable jacket and insulation without damage to the conductor.

Install terminals or terminal connectors as required, ensuring a firm metal-to-metal contact.

Reducing pin terminals (if required and approved for use by Engineer) shall be installed where 600V power cables have been oversized and will not fit into mechanical connections such as on molded case breakers.

Insulate each connection of cable to an insulated conductor (whether cable, bus, or equipment bushing). The insulation shall cover all exposed surfaces of the conductors; the insulation voltage level of the completed termination shall be not less than the insulation voltage level of the connected conductors.

Instrument cable shields and drain wires shall remain on the pair as close to the termination point as practical. Shields shall be permanently taped to prevent unraveling and the drain wires shall have insulating sleeves installed up to the point of termination.

16925.3.4.1 Insulation of 600 Volt Cable Connections. Where connections of cable rated 600 volts or less require insulation, all exposed conductor and connector surfaces shall be covered with tape in accordance with the following:

A minimum of four half-lapped layers of rubber tape, elongated not more than 20 percent, applied over the silicone rubber tape.

A minimum of three half-lapped layers of vinyl tape applied over the rubber tape. The vinyl tape shall extend a minimum of two cable diameters over the cable jacket and a similar distance over the insulation of the conductor to which the cable is connected.

16925.3.4.2 Not Used

16925.3.4.3 Not Used

16925.3.5 Tests After Placement

All insulated conductors shall be electrically tested after placement.

All circuits, including lighting circuits, shall be tested with the circuit complete except for connections to equipment. All splices, stress cones on shielded cable, and terminal connector attachments shall be complete prior to testing.

In addition to the tests performed after cable placement is complete, continuity tests shall be performed on all supervisory and communication cable before and after each splice is made.

Any circuit failing to test satisfactorily shall be replaced or repaired and then retested.

All equipment and labor required for testing shall be furnished by the Contractor.

The Contractor shall provide documentation of the tests on forms provided by the Engineer or acceptable to the Owner for each test performed.

16925.3.5.1 Continuity and Identification Tests. All insulated conductors shall be tested for continuity and conductor identification.

16925.3.5.1.1 Continuity Tests. Continuity tests shall include all tests necessary to confirm that each conductor is continuous throughout its entire length.

16925.3.5.1.2 Identification Tests. Identification tests shall include all tests necessary to confirm that the conductor being investigated originates and terminates at the locations designated in the Circuit List or indicated on the drawings.

16925.3.5.2 Insulation Tests. Resistance from ground provided by the insulation on all field-installed insulated power conductors shall be measured, excluding 120VAC non-essential power circuits.

16925.3.5.2.1 Not Used

16925.3.5.2.2 Cable Rated Below 5000 Volts. All insulated conductors, except supervisory and communication cable, rated less than 5000 volts shall be tested with a 1000 volt megger or an equivalent testing device. Insulation resistance measurements shall be made between each conductor and ground and between each conductor and all other conductors of the same circuit. Minimum acceptable resistance values shall be approximately 500 megohms.

16925.3.5.2.3 Supervisory and Communication Cable. All insulated conductors of supervisory and communication cable shall be tested for continuity.

16930 - Grounding Components and Installation

16930.1 General

This section covers the furnishing and field installation of a grounding system and all components. The grounding system and installation shall be in accordance with the drawings and these specifications.

16930.1.1 Scope of Supply

Any materials not specified as being furnished by others, but which are required for a complete grounding installation, shall be furnished.

16930.1.2 Not Used

16930.1.3 Performance and Design Requirements

Performance and design requirements for the equipment to be furnished under this section of these specifications are indicated herein.

16930.1.4 Codes and Standards

Work performed under these specifications shall be done in accordance with the following codes and standards. Unless otherwise specified, the applicable governing edition and addenda to be used for all references to codes or standards specified herein shall be interpreted to be the jurisdictionally approved edition and addenda. If a code or standard is not jurisdictionally mandated, then the current edition and addenda in effect at the date of this document shall apply.

Grounding systems and components furnished with these specifications shall be manufactured in accordance with applicable standards of the Institute of Electrical and Electronics Engineers, Inc. (IEEE), the National Electrical Manufacturers Association (NEMA), the American Society for Testing and Materials (ASTM), and Underwriters' Laboratories, Inc. (UL). Grounding systems and components shall be installed in accordance with the applicable requirements of the National Electrical Code (NEC) and the Occupational Safety and Health Administration (OSHA) standards.

16930.1.5 Materials

Grounding component materials shall be furnished new and undamaged.

16930.1.6 Approved Manufacturers of Components

For the following components, only the listed manufacturers are recognized as maintaining the level of quality of workmanship required by these specifications. If the Contractor wants to propose a non-listed manufacturer that is considered to provide an equivalent level of quality, this manufacturer must be identified and supporting testimony provided. Acceptance of the manufacturer as a substitute is at the discretion of the Engineer:

Component	Manufacturer
Ground rods	Blackburn Harger Erico, Inc.
Conductor	Rome Cable Corporation Southwire BICC - General
Bus and Bars	Erico Harger Thermoweld

Component	Manufacturer
Exothermal Welds	Erico (Cadweld) Harger Thermoweld Burndy (BurndyWeld)
Compression Connectors	Burndy Electrical Thomas and Betts ILSCO
Lugs - Exothermal / Mechanical	Erico (Cadweld) Harger Thermoweld Burndy (Burndy/Weld)
Lugs - Compression / Mechanical	Burndy Electrical Thomas and Betts ILSCO
Ground Plates	Erico (Cadweld) Burndy

16930.1.7 Not Used

16930.1.8 Not Used

16930.1.9 Supplemental Specifications

Technical supplemental specifications that are applicable to the work covered under this technical specification section are identified and included in Section 01400.

16930.2 Not Used

16930.3 Execution

16930.3.1 Grounding Components

An electrical grounding system shall be furnished and installed in accordance with the drawings and the following specifications. Grounding components shall include ground rods, ground conductor, ground bus, above and below grade grounding connections, grounding lugs, and hardware required for a complete system.

16930.3.1.1 Grounding Materials. Grounding component materials shall be furnished new and undamaged, and shall conform to the requirements of the articles that follow.

16930.3.1.1.1 Ground rods. Ground rods shall be copper clad, cold drawn carbon steel manufactured in accordance with UL 467. The copper cladding shall be electrolytically bonded to the steel rod or bonded by a molten welding process. Cold rolled copper cladding will not be acceptable. Ground rods shall have a conical taper on one end to facilitate soil penetration. Individual ground rods shall be 3/4 inch (19 mm) diameter and 10 feet (3 m) long. Ground rods shall be similar to Type ERITECH as manufactured by Erico, or an Engineer acceptable equal.

16930.3.1.1.2 Conductors. Bare ground conductor shall be soft drawn, stranded copper conforming to the requirements of ASTM B-8. Insulated ground conductor shall be soft drawn, stranded copper conforming to the requirements of UL 83. Insulated ground conductor shall be Type TW or THW having

green colored PVC insulation. Ground conductors shall be as manufactured by Rome Cable Corporation, or an Engineer acceptable equal.

16930.3.1.1.3 Bus bar. Ground bus bar shall be soft drawn, uncoated copper conforming to the requirements of ASTM B-187. Bus bar shall be a minimum 1/8 inch (3 mm) thick and 1 inch (25 mm) wide. Where required, bus bar shall be provided with predrilled holes measuring 9/16 inch (14 mm) in diameter with NEMA center line hole spacings. Bus bar shall be as manufactured by Erico, or an Engineer acceptable equal.

16930.3.1.1.4 Exothermal connections. Exothermal connections shall be a standard duty copper molten weld conforming to the requirements of IEEE 837, IEEE 80 Section 11, and UL 467. Molds and powder cartridges used for making exothermal connections shall be furnished by the same manufacturer. Exothermal connections shall be similar to Type CADWELD as manufactured by Erico, or an Engineer acceptable equal.

16930.3.1.1.5 Compression connections. Compression connections shall be irreversible, heavy-duty, copper crimps conforming to the requirements of IEEE 837 and UL 467. Compression fittings and compression tools and dies shall be furnished by the same manufacturer. Compression connections shall be similar to Type HYGROUND as manufactured by Burndy Electrical, or an Engineer acceptable equal.

16930.3.1.1.6 Ground lugs. Ground lugs shall be single hole or two hole, heavy-duty, copper bars conforming to the requirements of IEEE 837 and UL 467. Two hole ground lugs shall have NEMA center line hole spacings. Ground lugs used with the exothermal weld process shall be similar to Type LA as manufactured by Erico, or an Engineer acceptable equal. Ground lugs used with the compression process shall be similar to Type YGHA as manufactured by Burndy Electrical, or an Engineer acceptable equal.

16930.3.1.1.7 Ground plates. Ground plates shall be high strength, four hole copper bodies conforming to the requirements of IEEE 837 and UL 467. Ground plates shall have NEMA center line hole spacings and shall be provided with hole plugs on the mating side of the plate. Ground plates used with the exothermal weld process shall be similar to Type B164 as manufactured by Erico, or an Engineer acceptable equal. Ground plates used with the compression process shall be similar to Type YGF as manufactured by Burndy Electrical, or an Engineer acceptable equal.

16930.3.1.1.8 Hardware. Clamps, connectors, bolts, washers, nuts, and other hardware used with the grounding system shall be of copper, copper alloy, or stainless steel.

16930.3.2 Grounding Installation

Grounding system components shall be installed as indicated the drawings and as described in these specifications.

16930.3.2.1 Conductors. Exposed conductors shall be installed inconspicuously in vertical or horizontal positions on supporting structures. When located on irregular supporting surfaces or equipment, the conductors shall run parallel to or normal to dominant surfaces.

All below grade ground conductors shall be buried a minimum of 18 inches (450 mm) and a maximum of 30 inches (750 mm) below finished grade unless installed under a concrete foundation. Ground grid conductors under foundations shall have 6 inches of earth cover between conductor and bottom of foundation.

Conductors routed over concrete, steel, or equipment surfaces shall be kept in close contact with those surfaces by using fasteners located at intervals not to exceed 3 feet. Conductors routed around 90

degree corners shall be kept in close contact with the perpendicular surfaces and shall not be physically damaged due to an insufficient bending radius.

Below grade ground conductors shall be placed as indicated on the drawings.

Damaged ground system conductors shall be repaired or replaced.

16930.3.2.2 Ground Rods. All ground rods shall be located as indicated on the drawings and installed to the depth indicated. Where the required ground rod length exceeds 10 feet (3 m), ground rod standard sections shall be welded together to provide an extended rod with one true centerline a minimum of joint resistance. During welding, the ground rod sections being welded shall be supported by a guide to ensure proper alignment.

16930.3.2.3 Connections. All connections shall be made by the exothermal welding process except where otherwise indicated on the drawings or in these specifications. All surfaces to be joined by the welds shall be thoroughly cleaned. Powder cartridges and molds shall be kept dry and warm. Worn or damaged molds shall not be used.

The manufacturer's instructions on the use of exothermal welding materials shall be followed in all details.

All exothermally welded connections shall successfully resist moderate hammer blows. Any connection which fails such test, or which upon inspection indicates a porous or deformed weld, shall be remade.

All exothermal welds shall encompass 100 percent of the ends of the materials being welded. Welds that do not meet this requirement shall be remade.

All bolted and screwed connections shall be securely tightened.

Dies used in the compression tools shall be of the same manufacturer as the compression fittings. The manufacturer's instructions on the use of the compression tools and dies shall be followed in all details.

All bolted and screwed connections shall be securely tightened.

16930.3.2.4 Ground Plates. Ground plates embedded in concrete shall be carefully located as indicated on the drawings and firmly secured to the concrete forms. The threaded holes in the mating surface of round plates shall be plugged prior to pouring concrete. The grounding conductor attached to the ground plates shall be inspected prior to the pouring of concrete to ensure a good solid connection in accordance with industry standards.

16930.3.2.5 Column Grounding. Structural steel columns shall be grounded by use of a servit post installed in a pre-drilled hole in the web of the column near the base as indicate on the drawings. The Contractor shall provide a hole in the web of structural steel columns not so equipped for grounding provisions. The hole shall be 9/16 inch (14 mm) in diameter and located approximately 8 inches (200 m(m up from the base. Prior to the installation of the servit post, paint, scale, and other non-conductive substances shall be removed from surfaces of ungalvanized structural steel members by grinding. Galvanized steel surfaces shall be leaned with emery paper.

16930.3.2.6 Conduit Grounding. All conduit grounding bushings within all enclosures, including equipment enclosures, shall be wired together and connected internally to the enclosure grounding lug grounding bus with a bare copper conductor. Grounding bushings shall be grounded with conductor sized in accordance with the NEC, but not smaller than 8 AWG.

All grounding bushings on conduit runs which are terminated at tray shall be connected to the tray grounding cable or tray side rail with bare copper conductor as indicated on the drawings.

Where a conduit run is terminated at tray and the conduit carries a separate insulated grounding conductor, this grounding conductor shall be terminated on the tray grounding cable. If the conduit run is terminated with a grounding bushing and the separate ground conductor it carries is sized in accordance with the requirements of the preceding paragraphs for conduit bushing grounding, the ground conductor in the conduit run may be continued through the conduit bushing ground connection and terminated on the tray grounding cable making unnecessary the installation of a separate conduit bushing grounding cable.

Conduit bushing ground conductors shall be connected to the tray ground cable using split bolt connectors or an Engineer acceptable equal mechanical connector.

Conduit terminated at equipment and device in threaded hubs shall not require additional grounding provisions.

16930.3.2.7 Not Used

16930.3.2.8 Equipment Grounding. Electrical equipment that requires a ground grid extension stinger shall be connected to the ground grid with copper grounding conductor as indicated on the drawings. The term "electrical equipment," as used in this article, shall include all enclosures containing electrical connections or bare conductors except that individual devices such as solenoids, pressure switches, and limit switches shall be exempt from this requirement unless the device requires grounding for proper operation. Large electrical power distribution equipment such as medium or low voltage switchgear or motor control centers will be furnished with a ground bus which the Contractor shall connect to the ground grid at each end of the ground bus. Other equipment will be furnished with grounding pads and/or ground lugs which the Contractor shall connect to the ground grid. All ground connection surfaces shall be cleaned immediately prior to connection.

Where ground grid extension stingers are indicated on the drawings to be provided for connection to electrical equipment, the Contractor shall connect the grounding conductor to the equipment ground bus, pad, or lug. In addition to the ground grid extension stingers, a ground conductor shall be provided from the tray ground cable to the incoming line end of the ground bus in each assembly of medium or low voltage switchgear and motor control centers indicated on the drawings.

Where a ground conductor is included with the phase conductors of power circuits, the ground conductor shall be connected to the equipment grounding facilities and to the source ground bus. Where a ground conductor is not included with the phase conductors, the equipment shall be grounded by connecting a separate ground cable to the equipment grounding facilities and to the tray ground cable or source ground bus. Except where otherwise indicated on the drawings, all equipment ground conductors which are not an integral part of a cable assembly shall be sized in accordance with the requirements of NEC. All ground conductors installed in conduit shall be insulated.

Circuits in the circuit List include an insulated ground conductor to all 6,900 volt, 4,160 volt, 480 volt, and 208 volt loads to satisfy the requirements of the preceding paragraph. This ground conductor is either a separate cable, Type GI, or is contained within the multiconductor power cable. Power circuits from 120/208 volt power panels contain one additional conductor which is used for grounding smaller devices which require 120-volt power. Additional grounding cables which would duplicate the ground conductors already in the Circuit List are not required.

The Contractor shall design, furnish, and install all equipment grounding cables required in addition to the ground cables contained in the Circuit List. This shall include, but not be limited to, devices which have

electrical connections but do not require a power circuit such as junction boxes and control equipment enclosures, any equipment to which the routed ground conductor is not of sufficient size to properly ground the equipment, and any other electrical equipment which is not grounded by means of a conductor in the Circuit List.

Suitable grounding facilities shall be furnished on electrical equipment not so equipped. The grounding facilities shall consist of compression type terminal connectors bolted to the equipment frame or enclosure and providing a minimum of joint resistance.

Suitable grounding facilities for electrical equipment not so equipped, but requiring multiple grounding connections, shall include the installation of a bare copper ground bus for the connection of several grounding conductors. This ground bus shall be connected to the equipment frame or enclosure, providing a minimum of joint resistance.

The conduit system is not considered to be a grounding conductor except for itself and for lighting fixtures. No equipment grounding conductor shall be smaller in size than 12 AWG unless it is a part of an acceptable cable assembly.

16930.3.2.9 Not Used

16930.3.3 Ground System Resistance

All ground resistance measurements shall be made with the Fall of Potential or slope methods as defined in IEEE 81. Some of the acceptable instruments are as follows:

Advanced Geosciences, Inc., Sting R1, Mini Sting, Super Sting R1, or Super Sting R8

Iris Instruments, SYSCAL R1 Plus, SYSCAL R2, or SYSCAL Pro

After connection of ground rods to the ground system, the Contractor shall obtain a ground resistance measurement from a selected location on the ground grid, as indicated on the drawings, using methods approved by the Engineer. This data shall be obtained, identified, and recorded.

The ground resistance measurement data may indicate that additional ground rods are required. The Contractor shall furnish, install, and connect additional ground rods as necessary.

16935 - Lightning Protection

16935.1 General

16935.1.1 Scope of Supply

Scope of supply shall include design, furnishing, and installation of lightning protection equipment as specified herein..

If the lightning protection system equipment to be furnished under this specification is part of the scope of work under a larger procurement package to be designed and furnished by the Contractor, the scope of lightning protection system equipment to be furnished will be determined by Contractor's overall design:

Structures Requiring Lightning Protection	Description
CFOA-TNK-001	Fuel Oil Storage Tank No. 1
CFOA-TNK-002	Fuel Oil Storage Tank No. 2
CWSH-TNK-001	Demineralized Water Storage Tank No. 1

16935.1.2 Not Used

16935.1.3 Performance and Design Requirements

Performance and design requirements for the lightning protection system shall meet the requirements to obtain UL Master Label.

16935.1.4 Codes and Standards

Work performed under these specifications shall be done in accordance with the following codes and standards. Unless otherwise specified, the applicable governing edition and addenda to be used for all references to codes or standards specified herein shall be interpreted to be the jurisdictionally approved edition and addenda. If a code or standard is not jurisdictionally mandated, then the current edition and addenda in effect at the date of this document shall apply. These references shall govern the work except where they conflict with the Owner's specifications. In case of conflict, the latter shall govern to the extent of such difference:

Work	In Accordance With
Lightning protection (U.S.)	NFPA 780 - 2008, "Standard for the Installation of Lightning Protection Systems" UL 96 - 1994, "Standard for Lightning Protection Components" UL 96A - 1994, "Standard for Installation Requirements for Lightning Protection Systems" LPI-175, "Standard of Practice" LPI-175, "Material Standard"

16935.1.5 Not Used

16935.1.6 Approved Manufacturers of Components

For the following components, only the listed manufacturers are recognized as maintaining the level of quality of workmanship required by these specifications. If the Contractor wants to propose a nonlisted manufacturer that is considered to provide an equivalent level of quality, this manufacturer must be identified and supporting testimony provided. Acceptance of the manufacturer as a substitute is at the discretion of the Owner:

Component	Manufacturer
Lightning Protection Equipment	A-C Lightning Security, Inc., Maryville, Missouri National Lightning Protection Corporation, Denver, Colorado Robbins Lightning, Inc., Maryville, Missouri Heary Bros. Lightning Protection, Springville, New York East Coast Lightning Equipment, Inc., Winsted, Connecticut Independent Protection Equipment, Goshen, Indiana Thompson Lightning Protection, Inc.

16935.1.7 Test Requirements

Testing shall be conducted in accordance with the requirements to obtain UL Master Label. This testing is to be considered part of the defined Scope of Work, and all associated costs are the responsibility of the Contractor.

16935.1.8 Not Used

16935.1.9 Supplemental Specifications

Technical supplemental specifications that are applicable to the work covered under this technical specification section are identified and included in Section 01400.

16935.1.10 Certification Requirements

The following certificates shall be provided prior to Owner's acceptance:

Certificate	In Accordance With
UL Master Label	Section 16935.1.4 of this specification

16935.2 Products

16935.2.1 Lightning Protection - Design Requirements

The lightning protection system design shall be in accordance with the following requirements.

16935.2.1.1 Description. The system shall consist of air terminals, air terminal bases, interconnecting conductors, down-conductors, through-roof and through-wall assemblies, conductor holders, splicers, exothermal welds, fasteners, mounting accessories, heavy-duty stack materials, grounded metal objects on or within the structure as necessary, ground rods at each down-conductor, and connection of down-conductors to a grounding system. The system shall be designed to appear as part of the structure. Exposed roof conductors shall be placed so as to require a minimum displacement for future repair and maintenance of roofing.

Lightning protection system materials shall be in accordance with Article 16935.2.2. Lightning protection system installation shall be in accordance with Article 16935.3.

A complete lightning protection system shall be designed for the structures indicated in Article 16935.1.1. The system components shall comply with the specifications of the current edition of the codes and standards listed in Article 16935.1.4.

Air terminals and associated interconnecting conductor shall not be required for those parts of a structure located within a zone of protection.

When specified in Article 16935.1.8, the Contractor's design and equipment shall meet all requirements to receive any lightning protection installation certifications attainable under the applicable codes and standards for each structure specified to be protected. The Contractor's lightning protection system design and equipment furnished will not be considered acceptable prior to certification of each structure.

16935.2.1.2 Engineering Data. This article stipulates the requirements for engineering data that the Contractor shall submit for design information and review.

All engineering data shall be identified with the structure it represents by use of the nomenclature established by the Contract Documents.

Drawings shall be in sufficient detail to indicate the kind, size, arrangement, and operation of component materials and devices; the external connections, anchorages, and supports required; and the dimensions needed for installation and correlation with other materials and equipment.

16935.2.2 Lightning Protection System Materials

16935.2.2.1 General. System components shall generally be of copper or copper alloy except where installations will be on or adjacent to aluminum surfaces. Copper materials shall not be used for installation on aluminum surfaces or in locations near aluminum where moisture can run off copper components onto aluminum surfaces. In these locations, system components shall be of aluminum with suitable bimetallic transitions used at connection points to copper components.

All lightning protection components and materials shall be manufactured from corrosion-resistant materials. No combination of materials shall be used that forms an electrolytic couple of such nature that corrosion is accelerated in the presence of moisture.

Components shall comply with the requirements of the referenced codes and standards for the type and height of the building being protected.

Unless specified otherwise on the Lightning Protection Specification Sheet or required by a specific installation requirement, the materials shall be as follows.

16935.2.2.2 Air Terminals. Air terminals shall be solid, bare, round copper bar a minimum of 10 inches (254 mm) in length and diameter of 3/8 inch (9.5 mm) for Class I applications and 1/2 inch (13 mm) for Class II applications minimum, or as required by the referenced codes and standards.

16935.2.2.3 Copper Main Conductor (Cable) for Class I Applications. Main conductor for Class I applications shall be stranded copper constructed with a smooth weave or twisted configuration. The conductor for Class I applications shall have a minimum of 17 AWG (1 mm²) stranding, a minimum weight of 187 pounds (85 kg) per 1,000 feet (304.8 m), and a minimum cross-sectional area of 57,400 circ mils (33.63 mm²), or as required by the specified codes and standards.

16935.2.2.4 Copper Main Conductor (Cable) for Class II Applications. Main conductor for Class II applications shall be stranded copper constructed with a rope lay configuration. The conductor for Class II applications shall have a minimum of 15 AWG (1.5 mm²) stranding, a minimum weight of 375 pounds (170 kg) per 1,000 feet (304.7 m), and a minimum cross-sectional area of 115,000 circ mils (58 mm²), or as required by the specified codes and standards.

16935.2.2.5 Copper Secondary Conductor (Cable) for Class I or II Applications. Secondary conductor for Class I or Class II applications shall be stranded copper constructed with a smooth weave or twisted configuration. The conductor shall have a minimum of 17 AWG (1 mm²) stranding and a minimum cross-sectional area of 26,240 circ mils (13.30 mm²), or as required by the specified codes and standards.

16935.2.2.6 Aluminum Main Conductor (Cable) for Class I Applications. Main conductor for Class I applications shall be stranded aluminum constructed with a smooth weave configuration. The conductor for Class I applications shall have a minimum of 14 AWG (2.08 mm²) stranding, a minimum weight of 95 pounds (43 kg) per 1,000 feet (304.8 m), and a minimum cross-sectional area of 98,600 circ mils (50 mm²), or as required by the specified codes and standards.

16935.2.2.7 Aluminum Main Conductor (Cable) for Class II Applications. Main conductor for Class II applications shall be stranded aluminum constructed with a concentric configuration. The conductor for Class II applications shall have a minimum of 13 AWG (2.5 mm²) stranding, a minimum weight of 190 pounds (86 kg) per 1,000 feet (304.7 m), and a minimum cross-sectional area of 192,000 circ mils (97.2 mm²), or as required by the specified codes and standards.

16935.2.2.8 Aluminum Secondary Conductor (Cable) for Class I or II Applications. Secondary conductor for Class I or Class II applications shall be stranded aluminum constructed with a smooth weave configuration. The conductor shall have a minimum of 14 AWG (2.08 mm²) stranding and a minimum cross-sectional area of 41,100 circ mils (20.8 mm²), or as required by the specified codes and standards.

16935.2.2.9 Air Terminal Bases. Air terminal bases shall be as specified herein and as shown on the drawings for the roofing materials they will be mounted on.

16935.2.2.9.1 Adjustable point air terminal bases. Adjustable point air terminal bases shall be cast bronze or aluminum with an adjustable swivel point for connection of the air terminals specified herein. The adjustable point air terminal bases shall be constructed so they can be installed on a ridged roof, with a sloping, flat, or vertical surface. The air terminal bases shall have four holes for mounting. The air terminal bases shall provide positive single bolt tension cable clamping. Crimp type connectors at bases are not acceptable.

16935.2.2.9.2 Adhesive mounted air terminal bases. Adhesive mounted air terminal bases shall be cast bronze or aluminum. The adhesive mounting bases shall provide positive bolt tension cable clamping.

16935.2.2.9.3 Standing seam air terminal bases. Standing seam air terminal bases shall be cast bronze or aluminum, complete with a connection location for the air terminals specified herein. The standing seam air terminal bases shall be constructed with a bottom groove a minimum of 1/2 inch (13 mm) wide by 3/4 inch (19 mm) deep, and complete with two setscrews for securing to the standing seam. Each base shall have positive single bolt tension cable connectors for conductors that run parallel or perpendicular to the standing seam. Crimp type connectors at bases are not acceptable.

16935.2.2.9.4 Handrail mounting bases. Handrail mounting bases shall be cast bronze or aluminum and shall have provisions for connecting the air terminals and conductors specified herein. Handrail mounting bases shall be sized to fit securely into handrails.

16935.2.2.9.5 Tee mounted air terminal bases. Tee mounted air terminal bases shall be cast bronze or aluminum. The tee mounting bases shall provide positive bolt tension cable clamping for one cable run and one cable tap.

16935.2.2.9.6 Adjustable point adapters. Adjustable point adapters shall be provided for all air terminal mounting bases that would not otherwise allow the air terminal to be installed perpendicular to the ground. Adjustable point adapters shall be cast bronze or aluminum and shall include a means for tightening with a locking washer and/or nut.

16935.2.2.10 Through-Roof and Through-Wall Assemblies and Accessories. Through-roof and through-wall assemblies and accessories shall be furnished as specified herein and as shown on the drawings.

16935.2.2.10.1 Through-roof air terminal adapter assemblies. Through-roof air terminal adapter assemblies shall consist of a 1/2 inch (13 mm) diameter threaded rod, minimum 12 inches (305 mm) in length. Each assembly shall be furnished complete with two washers, two nuts, and a neoprene washer for weatherproofing a roof penetration. The lower end of the assembly shall be furnished with a universal parallel conductor connection, which will accept up to two conductors as specified herein. The top end of the assembly shall be furnished with an adjustable swivel point adapter for connection of the air terminals specified herein. The assembly shall be furnished complete with all the mounting provisions required to protect the roof against leaks. All components of the assembly shall be manufactured from materials that are compatible with the system being installed.

16935.2.2.10.2 Through-roof conductor-to-conductor assemblies. Through-roof conductor-to-conductor assemblies shall consist of a 1/2 inch (13 mm) diameter rod, a minimum 12 inches (305 mm) in length. Each assembly shall be furnished complete with two washers, two nuts, and a neoprene washer for weatherproofing a roof penetration. Each end of the assembly shall be furnished with a universal parallel conductor connection, which will accept up to two conductors as specified herein. All components of the assembly shall be manufactured from materials that are compatible with the system being installed.

16935.2.2.11 Conductor Holder. Conductor holders for connecting lightning protection conductors to structural steel shall be cast bronze or aluminum, and shall provide a minimum of 1.5 square inches (968 square mm) of positive bolt tension pressure. Each conductor holder shall be capable of holding the conductors specified herein. If copper conductor holders are specified in Article 16935.1.1, they shall be a 1 inch (25 mm) wide solid copper cable strap that forms around the conductors specified herein when installed, and shall be capable of being installed on a horizontal or vertical surface.

16935.2.2.11.1 Standing seam conductor holder. Standing seam conductor holders shall be brass or aluminum, constructed with a bottom groove a minimum of 1/2 inch (13 mm) wide by 3/4 inch (19 mm) deep and complete with a set screw for securing to the standing seam. Each standing seam conductor holder shall be capable of attaching the conductors specified herein when routed either parallel or perpendicular to the standing seam with a cable fastener as specified herein.

16935.2.2.11.2 Adhesive conductor holder. Adhesive conductor holders shall be capable of being installed on a horizontal or vertical surface and shall form around the conductors specified herein when installed. Adhesive conductor holders shall be cast bronze or aluminum. Each conductor holder shall be capable of holding the conductors specified herein.

16935.2.2.12 Splicers. Splicers for various applications shall be as specified herein.

16935.2.2.12.1 Parallel splicers. Parallel splicers shall be cast bronze or aluminum with positive bolt tension grip on conductors. Parallel splicers shall have provisions for connecting up to two conductors of the type specified herein and shall have a minimum total contact length of 1.5 inches (38 mm) parallel to the conductor.

16935.2.2.12.2 Butt end straight splicers. Butt end straight splicers shall be brass or aluminum and shall accept the conductors as specified herein. Butt end straight splicers shall be furnished with a minimum of two setscrews on each end of the splicer for connecting the conductor.

16935.2.2.12.3 Tee splicers. Tee splicers shall be cast bronze or aluminum and shall accept the conductors as specified herein. Tee splicers shall provide positive bolt tension grip on conductors.

16935.2.2.12.4 Four-way or cross-run splicers/connectors. Four-way or cross-run splicers or connectors shall be cast bronze or aluminum and shall be furnished complete with four bolts for positive bolt tension grip on conductors. The connectors shall be sized to accept two conductors as specified herein.

16935.2.2.13 Exothermal Welds. Welding charge formulation, equipment selection, and welding procedures shall be as recommended by the manufacturer of the exothermal weld materials for the size, shape, and composition of the materials being welded.

16935.2.2.14 Fasteners. Fasteners for various applications shall be as specified herein.

16935.2.2.14.1 Flat metal bonding plate. Flat metal bonding plates shall be cast bronze or aluminum with a minimum surface contact area of 3 square inches (1,935 square mm). Each bonding plate shall be furnished complete with bronze or aluminum screws for mounting.

16935.2.2.14.2 Cable fasteners. Cable fasteners shall be 5/8 inch (16 mm) wide solid copper or aluminum cable straps that form around the conductors specified herein when installed. The fasteners shall be capable of being installed on a horizontal or vertical surface.

16935.2.2.14.3 Pipe bonding clamps. Pipe bonding clamps shall be lead coated copper or aluminum and shall have provisions for connecting the conductors as specified herein. Pipe bonding clamps shall be sized according to the piping that requires bonding.

16935.2.2.15 Mounting Accessories. Mounting accessories used in the lightning protection systems shall be in accordance with the articles that follow.

16935.2.2.15.1 Neoprene sealing washers. Lightning protection components supplied with holes for permanent mounting that require drilling holes through the roof material shall be sealed with neoprene sealing washers for weatherproofing the roof connection points. Neoprene sealing washers shall be sized for the type of mounting provisions required.

16935.2.2.15.2 Concrete anchors with stainless steel nail. Concrete anchors shall be one-piece drive in type furnished complete with a stainless steel nail, 1/4 inch (6.35 mm) by 1-1/4 inch (32 mm).

16935.2.2.15.3 Sheet metal screws. Sheet metal screws shall be stainless steel hex head slotted, #10 by 1 inch (13 mm).

16935.2.2.15.4 Silicon sealant. Silicon sealant shall form a long lasting, flexible, watertight, and weatherproof seal. Silicon sealant shall be odorless and shall be paintable when dry. Silicon sealant shall be clear and shall be furnished in 10.1 ounce (0.3 L) tubes for use in a caulking gun.

16935.2.2.15.5 Protector piping. Protector piping shall be polyvinylchloride (PVC) 1 inch (25 mm) outside diameter pipe. Each protector pipe shall be furnished complete with all hardware for mounting the protector pipe to structural steel, sheet metal, or a concrete wall.

16935.2.2.15.6 Adhesive compound. Fast drying adhesive compound shall be used.

16935.2.3 Heavy-Duty Stack Materials

Heavy-duty stack materials shall be furnished as specified in the following articles.

16935.2.3.1 Heavy-Duty Stack Conductor. Heavy-duty stack conductor shall be stranded copper constructed with a rope lay configuration. The conductor shall have a minimum of 15 AWG (1.5 mm²) stranding, a minimum weight of 375 pounds (170 kg) per 1,000 feet (304.8 m) (excluding the lead coating), and a minimum cross-sectional area of 115,000 circ mils (58.2 mm²). Heavy-duty stack conductor shall be supplied with a continuous pure lead sheath, 1/16 inch (1.6 mm) thickness.

16935.2.3.2 Heavy-Duty Stack Air Terminals. Heavy-duty stack air terminals shall be solid copper rod, 24 inches (610 mm) in length, and a minimum diameter of 5/8 inch (15 mm) (excluding the lead coating). Heavy-duty stack air terminals shall be lead coated a minimum of 1/16 inch (1.6 mm) on all surfaces. Each heavy-duty stack air terminal shall be provided with not less than five full threads for attachment to the mounting bases specified herein.

16935.2.3.3 Heavy-Duty Stack Point Bases. Heavy-duty stack point bases shall have provisions for connecting a horizontal run and a vertical run of conductor as specified herein as well as a 5/8 inch (15 mm) air terminal as specified herein. The point bases shall be lead coated brass, a minimum of 1/16 inch (1.6 mm) on all surfaces, and complete with a 1/2 inch (13 mm) diameter, "LONG" 1-1/2 inch (38 mm) stud for anchoring. Point bases shall be furnished complete with anchoring hardware for mounting.

16935.2.3.4 Air Terminal Fasteners. Air terminal fasteners shall be lead coated bronze, a minimum of 1/16 inch (1.6 mm) on all surfaces, 2-bolt cap type point fasteners for use with heavy-duty stack air terminals as specified herein. Air terminal fasteners shall have a "LONG" 1-1/2 inch (38 mm) stud length for anchoring. All fasteners shall be furnished complete with all necessary hardware for anchoring to a concrete wall.

16935.2.3.5 Cross-Run Splicers. Cross-run splicers shall be cast heavy-duty bare brass and shall have provisions for connecting a vertical and horizontal run of conductor as specified herein. Each cross-run splicer shall be provided with four bolts for anchoring and shall be furnished complete with all necessary hardware anchoring to a concrete wall.

16935.2.3.6 Conductor Fasteners. Conductor fasteners for the bare conductor shall be bare bronze, 2-bolt cap type conductor fasteners for use with conductor as specified herein. Conductor fasteners shall have a 1/2 inch (13 mm) diameter, "LONG" 1-1/2 inch (38 mm) stud for anchoring. All fasteners shall be furnished complete with all necessary hardware for anchoring to a concrete wall.

16935.2.3.7 Conductor Fasteners (Corrosive Environment). Conductor fasteners for the lead coated conductor shall be lead coated bronze, a minimum of 1/16 inch (1.6 mm) on all surfaces, 2-bolt cap type point fasteners for use with conductor as specified herein. Conductor fasteners shall have a 1/2 inch (13 mm) diameter, "LONG" 1-1/2 inch (38 mm) stud for anchoring. All fasteners shall be furnished complete with all necessary hardware for anchoring to a concrete wall.

16935.2.3.8 Conductor to Plate Fasteners. Conductor to plate fasteners shall be bare brass with provisions for connecting the conductor as specified herein. Each conductor to plate fastener shall have a mounting stud that will connect to the 1/2 inch (13 mm) tapped hole as specified in rebar connecting assembly, with a length as required.

16935.2.3.9 Conductor to Plate Fasteners (Corrosive Environment). Conductor to plate fasteners shall be lead coated brass, a minimum of 1/16 inch (1.6 mm) on all surfaces, with provisions for connecting the conductor as specified herein. Each conductor to plate fastener shall have a mounting stud that will connect to the 1/2 inch (13 mm) tapped hole as specified in rebar connecting assembly, with a length as required.

16935.2.3.10 Rebar Connecting Assembly. Rebar connecting assemblies shall be furnished complete with a flush mount brass plate, bare copper conductor, and rebar bonding clamps. The flush mount brass plate shall be 4 inches by 4 inches (102 mm by 102 mm) and shall have a 1/2 inch (13 mm) diameter tapped hole for connecting to conductor to plate fasteners as specified herein. Three feet (914 mm) of copper conductor shall be furnished between each rebar bonding clamp and the brass plate. Rebar bonding clamps shall be cast bronze universal conductor to rebar bonding clamps. Rebar bonding clamps shall be sized to accommodate conductor sizes through 4/0 AWG (107.2 mm²) and reinforcing bars up through 1 inch (25.4 mm) diameter. Rebar connecting assembly shall have provisions for connecting 5 rebars.

16935.2.3.11 Terminal Lugs. Terminal lugs shall be bare brass, cast heavy-duty terminal bonding lug with eye connector. Each terminal lug shall be complete with two setscrews for connecting to the conductor as specified herein. Terminal lugs shall be furnished complete with hardware for mounting to structural steel.

16935.2.3.12 Terminal Lugs (Corrosive Environment). Terminal lugs shall be cast heavy-duty lead coated brass, a minimum of 1/16 inch (1.6 mm) on all surfaces, terminal bonding lug with eye connector. Each terminal lug shall be complete with two setscrews for connecting to the conductor as specified herein. Terminal lugs shall be furnished complete with hardware for mounting to structural steel.

16935.2.3.13 Parallel Splicers. Parallel splicers shall have provisions for connecting two conductors as specified herein in parallel. Parallel splicers shall be bare brass.

16935.2.3.14 Parallel Splicers (Corrosive Environments). Parallel splicers shall have provisions for connecting two conductors as specified herein in parallel. Parallel splicers shall be lead coated brass, a minimum of 1/16 inch (1.6 mm) on all surfaces.

16935.2.3.15 Butt End Splicers (Setscrew Type). Butt end splicers shall be cast heavy-duty bare brass and shall accept the conductor as specified herein. Butt end splicers shall be furnished with a minimum of two setscrews on each end for connecting the conductor. Butt end splicers shall withstand a pull test of 890 N when installed and shall make contact with the conductor for a minimum distance of 1-1/2 inches (38 mm), measured parallel to the conductor.

16935.2.3.16 Butt End Splicers (Compression Type). Butt end splicers shall be made from 14 gauge (1.63 mm) copper and shall accept the conductors as specified herein. Butt end splicers shall have compression type fingers to crimp over the conductor.

16935.2.3.17 Tee Splicers. Tee splicers shall be made from 14 gauge (1.63 mm) copper and shall accept the conductors as specified herein. Tee splicers shall have compression type fingers to crimp over the conductor.

16935.3 Execution

16935.3.1 General

This section covers the construction specifications to install a complete lightning protection system for the structures indicated in Article 16935.1.1. The systems shall comply with the specifications of the current edition of the codes and standards listed in Article 16935.1.4. The installation shall be accomplished by an experienced installer, who is certified under the applicable codes and standards.

16935.3.2 Description

The system shall consist of air terminals, interconnecting conductors, down-conductors, connections to a grounding system, and bonding of grounded metal objects on or within the structure as necessary. The system shall be designed to appear as part of the structure. Conductor runs for the structure shall be concealed where possible and practical. Exposed roof conductors shall be placed to require a minimum displacement for future repair and maintenance of roofing.

The Contractor shall evaluate the need for lightning protection on all other structures based on codes and standards listed in Article 16935.1.4. Any unidentified structure requiring lightning protection shall be brought to the attention of the Engineer. The Contractor shall include all required structures within the scope of the plant lightning protection system.

16935.3.3 Installation

The Contractor shall install a complete lightning protection system for the structures based on the codes and standards included herein and as indicated on the Engineer approved design drawings. Installation shall comply with the codes and standards referenced herein and with the following articles.

Copper materials shall not be used for installation on aluminum surfaces or in locations near aluminum where moisture can run off copper components onto aluminum surfaces. Connectors and fittings shall be suitable for use with the conductor and surfaces on which they are installed.

16935.3.3.1 Air Terminals. Air terminals shall be mounted to extend a minimum of 10 inches (254 mm) above the object to be protected, or as required by the referenced codes and standards. Spacing of air terminals on ridges or edges of roofs shall not exceed 20 feet (6.1 m) on centers nor be more than 24 inches (610 mm) from the ridge ends or roof edges, or as required by the referenced codes and standards. Air terminals that extend a minimum of 24 inches (610 mm) above the object to be protected shall not exceed 25 feet (7.62 m) spacing on centers. On flat or gently sloping roofs, additional air terminals shall be located at intervals not exceeding 50 feet (15 m) on centers.

16935.3.3.2 Conductors. A complete cable system with related air terminals, splices, and bonds shall be used on each structure not inherently self-protecting. Conductors of the size required by codes and standards referenced herein shall interconnect all air terminals and provide a two-way path to ground from each air terminal. Conductors shall maintain a horizontal and/or downward path from each air terminal to ground without forming "U" or "V" pockets. All center roof air terminals shall be interconnected with conductors to the outside perimeter cable. Conductors on the flat roof areas may be run exposed. Down-conductors shall be installed around the perimeter of each roof in a minimum of two locations and at a maximum of 100 feet (30.48 m) on centers.

Down-conductors routed to the structural steel from the roof system shall not be brought directly through the roof. Through-roof connectors shall be utilized for this purpose.

Dissimilar metal components shall not be connected together except by means of an approved bimetal transition fitting.

16935.3.3.3 Exothermal Welds. This article covers requirements for exothermal welding, including but not restricted to, cable-to-cable, cable-to-rod, and cable-to-steel structure connections.

Exothermal welds shall be made using new molds, sleeves, and cartridges sized in accordance with the welding equipment manufacturer's recommendations for the particular application.

Completed welds shall be capable of withstanding moderate hammer blows. Porous or deformed welds will not be acceptable.

The Owner may reject any connection if it fails when the cable is pulled; breaks loose from the structural steel when struck at an angle with a hammer; or does not appear to be a complete, properly shaped, and made connection. Inspection by the Owner in no way relieves the Contractor/Subcontractor of responsibility for the performance of the connection.

16935.3.3.4 Bonding Metal Bodies. All metal bodies within 6 feet (1,829 mm) of a lightning protection conductor, or as required by the referenced codes and standards, shall be bonded to the system with approved fittings and conductor. Connections between dissimilar metals shall be made with approved bimetallic connections.

16935.3.3.4.1 Metal bodies of conductance. Bonding of all metallic objects and systems at roof levels and elsewhere on the structure shall be complete. Primary bonds for metal bodies of conductance shall be bonded with appropriate fittings and full size conductor. Metal bodies of conductance shall consist of, but not be limited to, the following:

- Roof exhaust fans and vents.

- HVAC units with related piping and ductwork.

- Other roof piping systems.

- Roof handrails and ladders.

- Antenna masts.

- Exterior architectural metal fascia and/or curtain walls or mullions, which extend the full height of the structure, if not inherently bonded through the structure frame.

16935.3.3.4.2 Metal bodies of inductance. Metal bodies of inductance located within 6 feet (1,829 mm) of a conductor or object with secondary bonds, or as required by the referenced codes and standards, shall be bonded with secondary cable and fittings. Metal bodies of inductance shall consist of, but not be limited to, the following:

- Roof flashing.

- Parapet coping caps.

- Isolated metal building panels or siding.

- Roof drains and downspouts.

16935.3.3.5 Fasteners. Fasteners shall be placed on each run of exposed conductor not more than 3 feet (914 mm) apart to the medium on which it is routed, or as required by the referenced codes and

standards. Concealed runs of conductor shall be anchored as necessary to maintain position and hold permanently in place.

16935.3.3.6 Connections. Splices in main conductor runs and connections to branches shall be made with pressure type bolted or compression type connectors. Underground connections shall be by exothermal welding or Burndy, Hy-Ground compression type connections or acceptable equal.

16935.3.3.7 Grounding. Each ground shall terminate in a properly made ground connection to a Contractor-furnished ground rod and to the existing below grade grounding system. Down-conductors shall be routed a minimum of 18 inches (457 mm) below grade.

16935.3.3.8 System Certification. The installing Contractor and a representative of the Owner shall complete any applicable application for inspection. The Owner will witness and sign for the concealed grounding portion of the system. The Contractor and Owner will sign the form to signify the information being submitted as correct and their authorization of a completed project inspection by a local authority representative.

The Contractor at no additional charge to the Owner shall correct all areas noted by the field inspector as not being in compliance with current code requirements, such as products, components of the design, or misapplication in the installation. The project shall not be considered complete until applicable certificates according to the codes and standards are issued for each structure being protected.

16940 - Lighting Installation

16940.1 General

16940.1.1 Scope of Supply

Scope of supply shall include lighting systems installation as specified herein.

16940.1.2 Not Used

16940.1.3 Performance and Design Requirements

Performance and design requirements for the equipment to be installed under this section of these specifications are indicated herein.

In addition to the requirements of this section, the following requirements shall also apply:

Section 16501, Lighting.

Section 16920, Raceway Components and Installation.

Section 16925, Conductors Installation.

16940.1.4 Codes and Standards

Work performed under these specifications shall be done in accordance with the following codes and standards. Unless otherwise specified, the applicable governing edition and addenda to be used for all references to codes or standards specified herein shall be interpreted to be the jurisdictionally approved edition and addenda. If a code or standard is not jurisdictionally mandated, then the current edition and addenda in effect at the date of this document shall apply.

Work	In Accordance With
Lighting installation	NFPA 70 - National Electrical Code

16940.1.5 Not Used

16940.1.6 Not Used

16940.1.7 Test Requirements

The following testing shall be conducted in accordance with the specified source.

This testing is to be considered part of the defined Scope of Work, and all associated costs are the responsibility of the Contractor:

Tests	In Accordance With	Conducted By
Operational Test	NFPA 70	Contractor

Lighting Checkout. The Contractor shall test, check out, and energize the lights furnished and installed under this Contract. Lights shall be energized as soon as circuits are complete, to increase the lighting level for construction and checkout. Immediately before energizing a lighting circuit, the Contractor shall make the following checks:

The transformer neutral supplying the source panelboard is solidly connected to ground.

The phase and neutral conductors to be energized are free from grounds.

All covers are installed on luminaires, wiring devices, pull boxes, junction boxes, and conduit fittings so exposed conductors will not be energized.

The ground conductor is solidly grounded.

After completing the pre-energization checks, the Contractor may energize the circuit.

16940.1.8 Not Used

16940.1.9 Supplemental Specifications

Technical supplemental specifications that are applicable to the work covered under this technical specification section are identified and included in Section 01400.

16940.2 Not Used

16940.3 Execution

16940.3.1 Luminaires

Each complete luminaire shall be secured to its support assembly. This work includes, but is not limited to, all special drilling, assembling, disassembling, reassembling, and wiring.

Immediate lamp replacement, whenever burnouts occur, shall be continuous until the date of commercial operation.

Luminaire maintenance shall be continuous until the date of commercial operation.

16940.3.1.1 Location. Luminaire locations indicated on the drawings are approximate and shall be coordinated with other work in the same area to prevent interference between luminaires and piping, cable tray, duct work, or other equipment. Any luminaire shall be relocated if, after installation, it is found to interfere with other equipment or is so located to prevent its practical and intended use. No luminaire shall be located to prevent the full use of any accessway beneath a removable grating or slab or maintenance drop zone indicated on the drawings.

16940.3.1.2 Alignment. Luminaires installed in rows shall be carefully aligned vertically and horizontally. Luminaires and outlet boxes, mounted on building steel, shall be centered on the beam flanges or webs, except where deviations are required to avoid interference with piping, equipment, conduit, or miscellaneous steel.

16940.3.2 Wiring Devices

Wiring devices shall be installed in outlet boxes.

16940.3.2.1 Wiring Device Mounting Heights. Unless otherwise indicated on the drawings, the bottom of the wiring devices shall be mounted the following distances above the finished floor: Note that "finished areas" are defined as rooms with a suspended ceiling system, and "unfinished areas" are all other indoor locations:

Wiring Device	Location	Distance Above Floor
Convenience receptacles	Offices and finished areas	15 inches (380 mm)
	All other locations	35 inches (915 mm)
Switches	All locations	48 inches (1,220 mm)

16940.3.3 Lighting and Convenience Receptacle Conductors

The following requirements shall apply to the installation of lighting and convenience receptacle conductors in addition to applicable installation procedures specified in these specifications:

At least 6 inches (150 mm) of free conductor/cable shall be left at each outlet, except where the conductor/cable loops through an outlet without splice or connection.

Fixture wire (Type SF-2) shall be used to connect all incandescent luminaires. The fixture wire shall be installed in the circuit between the lighting circuit outlet box and luminaire terminal.

Wires to be spliced shall be twisted together prior to installation of the connector.

16940.3.4 Lighting and Convenience Receptacle Raceway

The following requirements shall apply to the installation of lighting and convenience receptacle raceway in addition to applicable installation procedures specified in these specifications:

Raceway installed in finished areas such as offices, locker rooms, toilets, control room, etc., shall be concealed in the walls, above the ceiling, or below the floor.

Conduit shall not be routed on the exterior surface of building walls.

17300 - Instrumentation

17300.1 General

Instruments shall be furnished in accordance with the requirements of the applicable sub-section and as specified herein. All instruments and ancillary devices supplied under this specification shall meet the hazardous area classification identified on the attached datasheets.

Instrument List

Instrument ID	Instrument Name	Manufacturer
CFOA-LI001	Fuel Oil Storage Tank 1 Level Indicator	Varec
CFOA-LI002	Fuel Oil Storage Tank 2 Level Indicator	Varec
CFOA-LT001	Fuel Oil Storage Tank 1 Level Transmitter	Magnetrol
CFOA-LT002	Fuel Oil Storage Tank 2 Level Transmitter	Magnetrol
CWSH-LT001	Demineralized Water Storage Tank 1 Level Transmitter	Rosemount

See drawing CFOA-E3001 and CWSH-E3010 for instrument model numbers.

17300.2 Materials

Materials received at the site having damaged or defective surfaces or surface coatings shall be repaired at the manufacturer's expense.

17300.3 Coatings

All metallic surfaces subject to corrosion, excluding stainless steel, shall be furnished with the manufacturer's standard paint or plating applied in the shop. Ferrous surfaces that should not be painted and are subject to corrosion should be coated with a rust-preventive compound. Surfaces that will be inaccessible after assembly shall be protected for the life of the equipment. Exposed surfaces shall be finished smooth, thoroughly cleaned, and filled as necessary to provide a smooth, uniform base for painting. The surfaces shall be cleaned and prepared in the shop. The Owner will approve rust-preventive compounds.

17300.4 Lubricants

An anti-seize compound or a spray lubricant shall be applied to all enclosure threads to prevent thread galling.

17300.5 Shipping and Storage Protection

Instruments that are flanged or are to be mounted between flanges shall be furnished with wooden flange face protectors. Instruments that have process, instrument air, or electrical connections shall be furnished with plugs or caps to protect instrument internals and threads. If more than one electrical connection is provided, a permanent electrical connection plug shall be furnished for each spare connection. Each instrument shipment weighing more than 200 pounds (91 kg) shall be packed in a weatherproof wooden crate for protection.

17300.6 Service Conditions

Instruments shall be constructed to withstand the service conditions of the systems to which they are connected. The suitability of each instrument shall be confirmed for the listed service conditions and the Owner shall be immediately advised of any required installation constraints.

17300.7 Transmitter Calibration

Each transmitter, including primary measuring devices with transmitter outputs, shall be calibrated and certified in accordance with the following.

17300.7.1 Factory Calibration

Each transmitter shall be factory calibrated to the engineering range shown in the applicable datasheets. Calibration shall include factory entry of the transmitter identification and any other data required to commission the transmitter for service. Data required for factory calibration are provided by the Owner in the datasheets attached to these specifications.

17300.7.2 Calibration Certification

Each transmitter shall be provided with a certificate of calibration that identifies it by model number, serial number, and tag number. The certificate shall include calibration data from at least five span points (0 percent, 25 percent, 50 percent, 75 percent, and 100 percent) to document both the expected and the measured transmitter current output for the specified measurement range. The certificate shall certify that all tests were performed with equipment whose calibration is directly traceable to the National Institute of Standards and Technology (NIST). Copies of the certificate shall be included in the instruction manuals.

17300.8 Not Used

17300.9 Not Used

17300.10 Engineering Data

Drawings, data, and reports shall be submitted to the Owner for review or record as specified in the supplemental sections and as below. All submitted drawings shall contain the following:

End user name.

Applicable unit number.

Device described in the drawings.

Black & Veatch specification number.

Contractor's project number.

Applicable device tag number.

17300.10.1 Not Used

17300.10.2 Not Used

17300.10.3 Not Used

17300.10.4 Transmitters, Converters, and Process Switches

The following shall be submitted to the Owner for review:

Drawings showing dimension data.

Model number.

Weight.

Terminal block arrangement and designation.

Other information specified on any attached drawings, datasheets or instrument lists.

17300.10.5 Certified Drawings

Drawings shall be furnished factory certified correct as-built for dimensions, calculations, material originations, and postweld stress relieving. Final flow element details and calculation results shall be tabulated in data sheet format similar to the Instrument Society of America primary element specification forms. If bound herein, any copies of the Primary Element Data Sheets shall be revised to show final data and shall be submitted to the Owner.

17300.10.6 Instruction Manuals

Refer to Supplemental Section Q501-Instruction Manuals for instructions regarding preparation and submittal of the preliminary and final instruction manuals. Replace the content of the instruction manual listed in Q501 with the information listed below:

Table of contents and index tabs.

Specifications.

Description of the equipment.

Operating instructions.

Instructions in the methods of receiving, inspection, storage, and handling.

Complete installation and maintenance instructions.

Assembly drawings.

Parts lists.

Nameplate information and shop numbers for each item of equipment and component part thereof.

List of recommended spare parts and prices.

List of maintenance tools furnished with the equipment.

MSDS if applicable or statement that MSDS is not applicable.

17300.11 Codes and Standards

Work performed under these specifications shall be in accordance with the following codes and standards. Unless otherwise specified, the applicable governing edition and addenda to be used for all references to codes or standards specified herein shall be interpreted to be the jurisdictionally approved edition and addenda. If a code or standard is not jurisdictionally mandated, then the current edition and addenda in effect at the date of this document shall apply. These references shall govern the work

except where they conflict with the Owner's specifications. In case of conflict, the latter shall govern to the extent of such difference:

Work	In Accordance With
Instrumentation	ANSI (American National Standards Institute)
	AGA (American Gas Association)
	API (American Petroleum Institute)
	ASME (American Society of Mechanical Engineers)
	ASTM (American Society for Testing and Materials)
	FM (Factory Mutual)
	IEEE (Institute of Electrical and Electronics Engineers)
	ISA (Instrument Society of America)
	NEMA (National Electrical Manufacturers Association)
Flanges	ANSI B16.5
Piping	ANSI B31.1

17301 - Stainless Steel Tags

17301.1 General

Stainless steel tags shall be furnished as specified herein and in accordance with Section 17300 - Instrumentation. In general, a stainless steel tag shall be furnished for each device that has an Owner identification number ("ID NUMBER") on the instrument list.

17301.2 Construction

Each stainless steel tag shall be attached to the instrument with stainless steel wire, rivets, ball chain, or ring. The first two lines of each tag shall be legibly stamped or engraved with the appropriate "ABBREVIATED DESCRIPTION" as shown on the instrument list; the same process shall be followed with the third line adding the appropriate "ID NUMBER." Each tag shall be constructed from stainless steel material at least 18 gauge in thickness.

17301.2.1 Size

Each tag shall be at least 1-1/4 inches by 2-1/2 inches (30 mm by 65 mm) in size. It shall hold at least three lines of text with not more than 20 characters per line.

17301.2.2 Text

Lettering shall be stamped, or engraved on a polished plate, with text at least 3/16 inch (5 mm) in height. Text shall be sized as large as possible within the size constraints of the tag. Stamping shall be done in such a manner that the information will remain readable if the tag is painted over.

17301.3 Not Used

17301.4 Not Used

17301.5 Manufacturer's Nameplates

In addition to the nameplate described above, a manufacturer may also furnish its standard nameplate. This manufacturer's standard nameplate shall also be stamped, engraved, with the Owner's "ID NUMBER." This nameplate shall be permanently attached to each instrument and shall include the manufacturer's standard information such as the following:

- Manufacturer's name or trademark.
- Serial number.
- Model number.
- Pressure rating.
- Body material.
- Tag number.
- Adjustable range.
- Input range.
- Output range.
- Power required.
- Explosion proof with CL, Div. & Grp. and UL or FM marking or stamp.
- Intrinsically safe equipment with CL, Div. & Grp. if limited where applicable.
- NEMA enclosure rating.

17910 - Instrumentation and Control Installation

17910.1 General

17910.1.1 Scope of Work

The work shall include the installation of any control and instrument panels, equipment, and devices described herein, as called for on drawings and specifications, and by the codes and standards. Installation of components indicated on the drawings listed in Article 17910.1.8 are included, except as otherwise specified herein.

The work includes, but is not limited to, the following:

Installation of the level transmitters as defined by the Owner in the drawings or herein.

Installation and mounting of weatherproof instrument enclosures for designated instruments mounted outdoors. If instruments are not factory mounted inside the enclosures, the Contractor shall be responsible for mounting the instrument inside the enclosure, in accordance with Owner requirements.

The Contractor shall furnish and install all necessary connections for testing the equipment.

17910.1.1.1 Scope of Structural Installation. The Contractor shall furnish and install all structural attachments required to support or attach equipment installed under this specification. Structural criteria pertaining to instrument and control installation shall be as described in this specification.

Concrete bases for panels and cabinets installed on finished concrete floors will be provided by others. The contractor shall furnish and install all accessories required to make use of these bases, including expansion anchors, nuts, screw anchors, shims, and other appurtenances as required.

The contractor shall furnish, fabricate, and install all miscellaneous supports for equipment being installed under this specification, including structural support steel, instrument stands, brackets, attachment fittings, bolts, studs, and other accessories as required. For enclosures, panels, and/or cabinets located in grating areas, the contractor shall furnish and install all required additional structural support steel for attachment of the enclosure, panel, or cabinet. All supports provided and installed by the contractor shall be suitable for the seismic rating required for the facility.

17910.1.1.2 Scope of Mechanical Installation. The contractor shall attach or mount all equipment he installs. The contractor shall perform any assembly operations required to complete the installation of equipment installed under this specification.

Instrument piping and tubing shall be installed in accordance with Section 17920, Instrument Piping and Tubing Installation.

In cases where instrument and control equipment is to be installed directly to process connections, as indicated on the Instrument Installation Details, the connections shall be furnished and installed by the contractor unless such connections are provided under other specifications. Where required, the contractor shall modify or adapt connections provided under other specifications using methods and procedures acceptable to the Owner. Orientation of directly connected devices shall be acceptable to the Owner.

17910.1.1.3 Scope of Electrical Installation. The contractor shall install electrical items, components, or conductors provided with or considered as integral parts of equipment installed under this specification unless specifically stated otherwise.

All electrical connections and wiring will be performed under Section 16925. Instrumentation consisting of a separate sensing element and electronics consisting of a control unit signal conditioner, junction box, or amplifier shall have split responsibility for installation. The contractor shall coordinate the installation with the owner. All electrical connections and wiring between the sensing element and the electronics shall be performed in accordance with electrical Sections 16925.

17910.1.1.4 Not Used

17910.1.1.5 Not Used

17910.1.2 Items Furnished by Others and Interfaces

Items not in this scope of supply include the following:

The Owner will perform the final checkout of the instruments (furnished by the Contractor) and program the DCS

17910.1.3 Performance and Design Requirements

Not used.

17910.1.4 Codes and Standards

Work performed under this specification shall be done in accordance with the following codes and standards. Unless otherwise specified, the applicable governing edition and addenda to be used for all references to codes or standards specified herein shall be interpreted to be the jurisdictionally approved edition and addenda. If a code or standard is not jurisdictionally mandated, then the current edition and addenda in effect at the date of this document shall apply. These references shall govern the work except where they conflict with the Owner's specifications. In case of conflict, the latter shall govern to the extent of such difference:

Work	In Accordance With

17910.1.5 Not Used

17910.1.6 Approved Manufacturers of Components

The contractor shall furnish only approved components by the manufacturers listed in Section 01400 that are recognized as maintaining the level of quality of workmanship required by this specification. If the Contractor wants to propose a nonlisted manufacturer that is considered to provide an equivalent level of quality, this manufacturer must be identified and supporting testimony provided. Acceptance of the manufacturer as a substitute is at the discretion of the Owner.

17910.1.7 Not Used

17910.1.8 Technical Attachments

The Piping and Instrument Diagram (P&ID), Instrument List (if furnished), and Instrument Installation Details are described below and attached to this specification:

Piping and Instrument Diagram (P&ID). Diagrams that schematically locate control and instrumentation devices relative to major plant piping systems and equipment.

Instrument Installation Details. Details that provide physical and schematic representations of methods for installing accessory items from the root valve to the instrument.

17910.1.9 Supplemental Specifications

Technical supplemental specifications that are applicable to the work covered under this technical specification section are identified and included in Section 01400.

17910.1.10 Not Used.

17910.2 Not Used

17910.3 Execution

17910.3.1 General

All controls and instrumentation shall be installed in accordance with the requirements of this section and the Instrument Installation Details. Any installation procedures not specified herein or in the Instrument Installation Details shall be done in accordance with the manufacturer's recommendations and good engineering practice and shall be acceptable to the Owner.

All controls and instrument installation and accessories shall be executed and supervised by personnel experienced in this type of work.

Sequence of installation work shall be coordinated with the Owner to support the project commissioning schedule.

17910.3.2 Installation of Locally Mounted Equipment

In addition to the installation requirements indicated on the drawings, the requirements specified herein shall apply:

Transmitters that are supplied with local indicators shall be installed so that the indicator is positioned to be easily read.

Panels shall be shimmed for proper alignment and bolted to their foundations or building structure as required. The panels shall be protected from damage during the construction period. Shipping crates modified to permit necessary access may be used for panel protection.

Level transmitters shall be installed on tanks as indicated on the drawings. Topworks of transmitters shall be rotated to positions that provide convenient access for calibration, operation, and maintenance. Such work shall be accomplished before installation of wiring to the devices.

All brackets, instrument stands, supports, and other miscellaneous hardware required for mounting devices shall be furnished and installed.

17910.3.3 Connection of Equipment and Devices

All instruments shall be installed in accordance with the manufacturers' instructions in the locations shown on the drawings.

18000 - Startup and Commissioning

Plant startup shall include activities, procedures, and tests required to bring installed systems and equipment to a state of readiness for Owner acceptance and commercial operation. This includes mechanical completion tests such as hydrostatic testing, initial operation and functional testing of equipment, and power plant performance tests. Contractor shall render services and activities required to place each item of materials and equipment installed by it, including auxiliaries, piping, and wiring, in operating condition. Contractor shall provide sufficient proof that the materials and equipment is operational, including, but not limited to, documented test and inspection reports, and other related documentation as deemed reasonably necessary by Owner. Individual systems and items of materials and equipment shall be completed in a sequence that will permit systematic checkout and trial operation of each such component before it is incorporated in the initial operation.

Startup of systems shall be conducted in accordance with written procedures; submit for Owner review.

Owner will furnish operating personnel during checkout and initial operation. Contractor's startup and commissioning plan shall include identification of Owner provided operating personnel resources that are anticipated to be required. Contractor shall provide other personnel required to make adjustments and correct deficiencies during the initial materials and equipment checking.

Contractor shall provide temporary instrumentation and other devices required during checkout and operation of materials and equipment and systems which it has installed.

Contractor shall furnish and apply, oils, greases, and other lubricants required to place materials and equipment in condition ready for operation.

18000.1 Mechanical Completion and Functional Testing

Mechanical Completion and functional testing shall be completed on a system-by-system basis. Appropriate documentation verifying mechanical completion and successful functional testing of systems and equipment shall be submitted to the Owner on a system-by-system basis for review and approval prior to Substantial Completion. Contractor shall provide a sample turnover package for Owner review. There shall be a turnover package assembled for each of the following systems:

- Fuel oil system, including all associated controls, instrumentation and lighting
- Fire detection and foam suppression system, including all instrumentation and controls
- Demineralized water system, including all associated controls, instrumentation and lighting

Each turnover package shall include the following documentation as a minimum:

18000.1.1 Package Title

18000.1.2 Package Scope and Narrative Description

18000.1.3 Package Status Section

This section shall contain Construction Completion Certificates, Startup Completion Certificates, System Turnover Acceptance Certificates, or other documentation pertinent to recording the status of the package.

18000.1.4 Outstanding Work & Deficiencies List Section (Punch list)

Contains construction punch list or turnover exceptions lists as appropriate.

18000.1.5 Mechanical Section

This section includes:

- Mechanical Equipment Scope List, containing all equipment designations as well as all OEM or operating & maintenance manuals and nameplate data
- Construction/Startup Mechanical Quality Certification
- Mechanical Construction/Startup Checkout Documentation forms utilized to document completion of mechanical construction and startup activities. Including checkout forms, testing records, startup checklists, verification sheets, alignment reports, vibration data sheet, lubrication data sheet, flushing and blowdown report, pressure test data report, equipment maintenance report, and vessel closure/ inspection report.

18000.1.6 Instrument & Control Section

This section includes I&C scope lists and Construction/Startup Checkout Documentation forms utilized to document completion of instrument and control construction and startup activities. The following are submittal documents:

- List of Non-motor Operated Control Devices, e.g. air, hydraulic, valves, and dampers
- List of Non-operated Control Devices such as instruments and analyzers
- Check out forms
- Testing records
- Startup checklists
- Verification sheets
- Flushing and blowdown report
- Pressure test data report
- Instrument calibration data sheets
- Equipment maintenance report

18000.1.7 Electrical Section

This section includes electrical scope lists for Construction/Startup and Electrical Quality Certification and Checkout Documentation. Forms utilized to document completion of electrical construction and startup activities:

- Power Circuits
- Control circuits
- Electrical Equipment
- Non-operated electrical control devices such as protective relays, meters, and transducers
- Testing records
- Startup checklists
- Verification sheets
- Circuit breaker test reports
- Dew point test reports
- Polarization index test report
- Capacitance and dissipation factor test reports
- Surge arrester test report
- Meter test report
- Relay test data sheets
- Megger test report
- High potential test report
- Ground resistance test report
- Battery installation and charging report
- Protective relay test report
- Equipment maintenance report

18000.1.8 Supplier / Miscellaneous Section

This section shall contain supplier or other reports not outlined elsewhere, and additional information as required for completing the detailed record of commissioning activities on that particular package. Reports may include such things as site visit reports and maintenance records.

18000.1.9 Package Drawings

Drawings shall be those as required to define scope of package, for example P&ID's, One line Diagrams, Schematics, Wiring Diagrams, Instrument loop diagrams, data sheets and reference drawings. Attached drawings shall be current issue with markups to reflect any field changes.

18000.2 Electrical Relay Testing and Commissioning

Owner will provide qualified personnel to accompany Contractor to witness relay setting and commissioning. Contractor shall build at least 4-weeks into schedule to complete this activity.

Prior to start of relay testing and commissioning activities, Contractor shall provide a complete relay coordination study to Owner for review and approval. The Owner shall have at least 2-weeks to review and comment on documentation. Contractor shall resolve discrepancies and comments prior to beginning of testing and commissioning.

APPENDIX B - LIST OF SUBCONTRACTORS FORM
**125-17 General Construction Services for Greenland Energy Center Fuel Oil
and Demineralized Water Storage Tank Additions**

JEA Solicitation Number 125-17 requires certain major Subcontractors be listed on this form, unless the work will be self-performed by the Company.

The undersigned understands that failure to submit the required Subcontractor information on this form will result in bid rejection, and the Company agrees to employ the Subcontractors specified below: (Use additional sheets as necessary)

Note: This list of Subcontractors shall not be modified subsequent to bid opening, without a showing of good cause and the written consent of JEA.

Type of Work	Corporate Name of Subcontractor	Subcontractor Primary Contact Person & Telephone Number	Subcontractor's License Number (if applicable)	Percentage of Work or Dollar Amount

Signed:_____

Company:_____

Address:_____

Date:_____

Appendix B Minimum Qualification Form

125-17 General Construction Services for Greenland Energy Center Fuel Oil and Demineralized Water Storage Tank Additions

GENERAL

THE MINIMUM QUALIFICATIONS SHALL BE SUBMITTED ON THIS FORM. IN ORDER TO BE CONSIDERED A QUALIFIED BIDDER BY JEA YOU MUST MEET THE MINIMUM QUALIFICATIONS LISTED BELOW, AND BE ABLE TO PROVIDE ALL THE SERVICES LISTED IN THIS SOLICITATION.

THE BIDDER MUST COMPLETE THE PROPOSER INFORMATION SECTION BELOW AND PROVIDE ANY OTHER INFORMATION OR REFERENCE REQUESTED. THE BIDDER MUST ALSO PROVIDE ANY ATTACHMENTS REQUESTED WITH THIS MINIMUM QUALIFICATIONS FORM.

PLEASE SUBMIT THE ORIGINAL AND TWO (2) COPIES AND ONE (1) CD OR THUMB DRIVE OF THIS FORM AND ANY REQUESTED ADDITIONAL DOCUMENTATION WITH THE BID SUBMISSION.

BIDDER INFORMATION

COMPANY NAME: _____

BUSINESS ADDRESS: _____

CITY, STATE, ZIP CODE: _____

TELEPHONE: _____

FAX: _____

E-MAIL: _____

PRINT NAME OF AUTHORIZED REPRESENTATIVE: _____

SIGNATURE OF AUTHORIZED REPRESENTATIVE: _____

NAME AND TITLE OF AUTHORIZED REPRESENTATIVE: _____

MINIMUM QUALIFICATIONS:

- The Bidder shall have successfully completed a minimum two (2) similar projects for the general construction services in support storage tank installation in an industrial or utility environment in the past five (5) years, ending in July 31, 2017. A similar project is a general construction project including earthwork, berm spill containment structure, foundations, instrumentation, electrical, lighting, and pipe support valued at greater than \$2,500,000.

REFERENCE 1

Customer Name _____

Customer Address _____

Reference Name _____

Reference Phone Number _____

Reference E-Mail Address _____

Contract Year/Amount _____

Description of Contract _____

REFERENCE 2

Customer Name _____

Customer Address _____

Reference Name _____

Reference Phone Number _____

Reference E-Mail Address_____

Contract Year/Amount _____

Description of Contract _____

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APPENDIX B
BID FORM FOR SOLICITATION # 125-17

**General Construction Services for Greenland Energy Center Fuel Oil
and Demineralized Water Storage Tank Additions**

Submit an **original, two (2) copies and one (1) CD** along with other required forms in a sealed envelope to: JEA Procurement Dept., 21 W. Church St., Bid Office, Customer Center, 1st Floor, Room 002, Jacksonville, FL 32202-3139.

Company Name: _____

Company's Address _____

License Number _____

Phone Number: _____ FAX No: _____ Email Address: _____

BID SECURITY REQUIREMENTS

- ☐ None required
☒ Certified Check or Bond Five Percent (5%)

TERM OF CONTRACT

- ☐ One Time Purchase
☐ Annual Requirements
☒ Other, Specify- Project Completion

SAMPLE REQUIREMENTS

- ☒ None required
☐ Samples required prior to Bid Opening
☐ Samples may be required subsequent to Bid Opening

SECTION 255.05, FLORIDA STATUTES CONTRACT BOND

- ☐ None required
☒ Bond required 100% of Bid Award

QUANTITIES

- ☒ Quantities indicated are exacting
☐ Quantities indicated reflect the approximate quantities to be purchased Throughout the Contract period and are subject to fluctuation in accordance with actual requirements.

INSURANCE REQUIREMENTS

Insurance required

PAYMENT DISCOUNTS

- ☐ 1% 20, net 30
☐ 2% 10, net 30
☐ Other _____
☐ None Offered

Item No.	ENTER YOUR BID FOR THE FOLLOWING DESCRIBED ARTICLES OR SERVICES:	LUMP SUM PRICE
1	TOTAL BID PRICE FOR SOLICITATION 125-17	\$ _____

☐ **I have read and understood the Sunshine Law/Public Records clauses contained within this solicitation. I understand that in the absence of a redacted copy my proposal will be disclosed to the public "as-is".**

BIDDER'S CERTIFICATION

By submitting this Bid, the Bidder certifies that it has read and reviewed all of the documents pertaining to this Solicitation, that the person signing below is an authorized representative of the Bidder's Company, that the Company is legally authorized to do business in the State of Florida, and that the Company maintains in active status an appropriate contractor's license for the work (if applicable). The Bidder also certifies that it complies with all sections (including but not limited to Conflict Of Interest and Ethics) of this Solicitation, and that the Bidder is an authorized distributor or manufacturer of the equipment that meets the Technical Specifications stated herein.

We have received addenda _____

_____ through _____

_____ Date
Handwritten Signature of Authorized Officer of Company or Agent

Printed Name and Title